Analysis of Water Quality Conditions and Trends for the Long-Term River Network: Athabasca River, 1960-2007

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Prepared by:

Thorsten Hebben, M.Sc., P.Biol.
Limnologist/Water Quality Specialist

Water Policy Branch
Environmental Assurance

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Any comments, questions, or suggestions regarding the content of this document may be directed to:

Water Policy Branch
Alberta Environment
7th Floor, Oxbridge Place
9820 – 106th Street
Edmonton, Alberta T5K 2J6
Phone: (780) 427-2654
Fax: (780) 422-6712

Additional copies of this document may be obtained by contacting:

Information Centre
Alberta Environment
Main Floor, Oxbridge Place
9820 – 106th Street
Edmonton, Alberta T5K 2J6
Phone: (780) 427-2700
Fax: (780) 422-4086
Email: env.infocent@gov.ab.ca

EXECUTIVE SUMMARY

Since the early 1950's, large rivers throughout the Province of Alberta have been subjected to regular monthly sampling for a broad suite of water quality parameters. Originally devised and overseen by Environment Canada, this comprehensive monitoring program was taken over by Alberta Environment in 1987. Now referred to as the Long-Term River Network (LTRN), the program has been expanded from its original 11 monitoring stations to include 29 sites on 13 rivers distributed throughout Alberta. Monthly sampling at these sites over an extended time frame has contributed to an extensive database of water quality information for the province. Due to the broad temporal coverage of these data, in addition to their general continuity and high quality, they lend themselves particularly well to statistical trend assessment. A very useful and reliable means of assessing changes in water quality parameters over time, the results of statistical trend assessment can be used for a host of purposes, including the development and evaluation of watershed management initiatives, the assessment of cumulative effects on water quality, and the prediction of future water quality conditions in a given system.

Although water quality monitoring on the Athabasca River began as early as 1955 for some variables, regular sampling for most parameters was not implemented until at least 1960. Initially, sampling efforts were limited to a single station at the Town of Athabasca. In 1977, a second site was established at Old Fort, 200 kilometres downstream of Fort McMurray. In more recent years, two additional sampling stations were created on the Athabasca River as a means of more effectively monitoring specific anthropogenic pressures, including forestry, pulp production, and resource extraction, on the river. These sites, situated upstream of both Hinton and Fort McMurray, were incorporated into the network in 1999 and 2002, respectively.

The purpose of this report is to provide both a general overview of water quality conditions in the Athabasca River, in the form of summary statistics and time series graphs for all four LTRN sites, and more in-depth statistical trend analyses on long-term data for the Athabasca and Old Fort monitoring stations. Sampling activities on the Athabasca River have frequently examined a wide range of trace organic contaminants (e.g., pesticides, priority pollutants, chlorinated phenolics, PAH). However, due to limited sampling frequency and relatively few detections, most data associated with these trace contaminants are inappropriate for statistical trend assessment. Analysis of these data is limited to basic summary statistics in this report.

Monotonic trend analyses of water quality data revealed trends in several variables at both the Athabasca and Old Fort sites. Stream flow at both locations was found to be decreasing since 1960. At the same time, turbidity, a number of nutrients, and some metals described significant increasing trends at the Old Fort (downstream) station. Relatively high turbidity, in association with high nutrients and metals, is characteristic of the lower Athabasca River and its tributaries and has resulted in frequent water quality guideline exceedances for several variables. Increasing trends in these parameters, however, suggest an additional influence on water quality in the river. Decreasing flows and, hence, a reduced dilution capacity for point source effluents may be partly responsible. However, anthropogenic disturbance in the watershed may also be a contributor. At this time, further investigation would be required to establish causal links with any degree of certainty.

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1.0 INTRODUCTION

The Athabasca River arises as a hard water, alkaline stream at the base of the Columbia Icefield in Jasper National Park (MRBB 2004, Noton & Saffran 1995). From its headwaters in the mountains, the river flows in a north-easterly direction, carving a channel through foothills, boreal forest, and forested Precambrian shield on its 1375 km journey to the Athabasca Delta and Lake Athabasca. On its way, it collects the waters of several major tributaries, including the McLeod, Pembina, Lesser Slave, and Clearwater Rivers. Numerous communities, including Jasper, Hinton, Whitecourt, Athabasca, Fort McMurray, and Fort MacKay, are situated on the river's banks and contribute to a population of more than 155,000 people in the basin (based on 2001 census, MRBB 2004). At the time of census, Fort McMurray contributed 41,466 people to this number. In recent years, this number has risen to 60,000 citizens (North-South 2007).

The Athabasca River basin is richly endowed with a range of resources, both renewable and non-renewable, which provide the basis for a variety of industries in the province of Alberta. In the upper reaches, near the towns of Hinton and Jasper, coal mining is a significant contributor to the local economy. Forestry activities are widespread throughout the basin and support a number of parallel undertakings, including sawmills, panel board factories, and pulp and newsprint mills (MRBB 2004). Pulp mills, of which there are now five on the Athabasca River system (North-South 2007), have been shown to exert adverse influences on water quality in the Athabasca River (Noton & Shaw 1989, Noton & Saffran 1995) Conventional oil and gas are extracted in several regions of the basin, while intensive oil sands development is ongoing in the area north of Fort McMurray. Agriculture, while not as extensive as in other regions of the province, accounts for roughly 12% of land use in the Athabasca River Basin (MRBB 2004). All of these activities, in conjunction with watershed geology, non-point source runoff from both natural and altered landscapes, and point source effluents from five wastewater treatment plants (North-South 2007), have the potential to affect water quality in the Athabasca River. Unlike other large rivers in Alberta, the Athabasca is not regulated by man-made structures. Hence, highly seasonal flows reflect climatic conditions, with lowest discharge during winter (North-South 2007). In conjunction with four to five months of extensive ice cover, this can further complicate the water quality picture (Noton, Mackenzie & Macdonald 1994).

Long-term water quality monitoring sites, situated on major rivers and lakes throughout Alberta, are used for a variety of purposes. Among their numerous applications, they may facilitate assessment of provincial regulatory programs, point- and non-point source pollution, pollution abatement technologies, watershed development activities, human population growth, and climate change, relative to their impacts on surface water quality. Moreover, since they are frequently located upstream and downstream of areas of major human development, they are also well-placed to support cumulative effects assessment. Environment Canada established two long-term monitoring sites on the Athabasca River at Athabasca and Old Fort, in 1960 and 1978, respectively. In 1987, Alberta Environment took over operation of both sites as part of the provincial Long-Term River Network (LTRN), a major water quality monitoring initiative. Partly in response to development pressures in the Athabasca River Basin, Alberta Environment subsequently incorporated two additional monitoring stations upstream of Hinton (1999) and Fort McMurray (2002) into the LTRN (Figure 1).

Due to a broad range of natural and anthropogenic influences, the water quality of rivers can vary substantially over time and space. Although single water samples have considerable value in describing general water quality conditions at a specific point in time, long-term monitoring can provide datasets that support the use of statistical trend assessment to help evaluate the influences of human activity and other factors over longer periods. These temporal tendencies, reported as trends in specific water quality variables, can be increasing (statistically significant positive slope), decreasing (statistically significant negative slope), or lacking a distinct tendency (statistically insignificant slope). In the case of LTRN sites, some of which have been monitored for upwards of 40 years, trend assessment can be a powerful tool in the evaluation of change.

The primary objectives of this report are:

a) to provide a general summary of water quality conditions for LTRN sites on the Athabasca River; and
b) to examine long-term trends in those data since 1960.

Although some findings are briefly discussed in the document, the intent was not to investigate potential causes for any perceived trends. Rather, the main purpose was to statistically assess the now-extensive dataset in order to establish the existence of trends in water quality variables over time and lay the groundwork for subsequent investigations into what has changed and why it might have done so. This is hoped to provide a factual foundation to support further evaluation, reporting, planning, and management in the future.

This report details the trend assessment process, water quality variable selection criteria for that process, and trend assessment results for an extensive suite of variables monitored since 1957 at the Athabasca and Old Fort LTRN sites on the Athabasca River (Figure 1). Since the monitoring stations situated at Hinton and Fort McMurray have been active for less than 10 years, they have not yet accumulated sufficient data for reliable trend assessments. Hence, they will only be considered in a limited statistical context at this time.

2.0 METHODS

2.1 Variable Selection and Treatment

For the sake of statistically defensible trend assessments on a given variable, an absolute minimum five years' worth of continuous monthly monitoring data is required (Schertz *et al.* 1991, Stevens 2003). However, a minimum 10 years' worth of results is generally recommended to ensure the robustness of specific trend analysis methodologies (Aroner 1994). With a few exceptions, variables not meeting this latter criterion were immediately excluded from trend analyses. In a small number of cases, variables with eight or nine years of continuous data with values consistently above method detection limits were included in statistical analyses. Following removal of variables with insufficient temporal coverage, all remaining data were examined graphically for the presence of extreme outliers (i.e., >2 standard deviations from the mean). Unless these could be explained by the field notes of technical personnel or corroborated by similar departures of related variables, they were excluded from analyses.

A wide range of water quality variables has been examined as part of regular LTRN sampling in the Athabasca River over the years (Table 1). However, depending on the parameter under consideration, the continuity of accumulated data can vary considerably (Figures 2-9). With this in mind, and for the purpose of creating a more comprehensive overview of water quality conditions in the Athabasca River, a number of parameters were variously manipulated. In some instances, variables deemed sufficiently similar after careful consideration were combined to create longer datasets. Specifically, turbidity values (formerly measured in Jackson Turbidity Units (JTU) and more recently in Nephelometric Turbidity Units (NTU)) were merged over the entire sampling history. For pH, values measured in the laboratory were incorporated where field measurements were unavailable for a given sampling date (pH values were not converted to hydrogen ion concentration prior to statistical manipulation). Similarly, gaps in dissolved oxygen concentrations obtained from field data were filled with those derived in the laboratory via Winkler titration. Due to the relatively brief record for apparent colour, fundamental differences in the ways that apparent colour and true colour are measured, and the integer (essentially categorical) nature of the latter, these two variables were not subjected to trend assessments. Lastly, measured hardness values were not always available for pre-1987 data at the Athabasca and Old Fort sites. Where this was the case, a calculated value, based on calcium and magnesium concentrations (Eaton *et al.* 2005), was inserted. Further information regarding surface water quality, sampling methods, and guidelines can be obtained from the Alberta Environment water quality sampling manual (AENV 2006), the Canadian Environmental Quality Guidelines (CCME 1999), or through the Surface Water Quality homepage (http://www3.gov.ab.ca/env/water/SWQ/index.cfm).

An extensive list of metals and related elements has been analysed in samples collected at the Athabasca River LTRN sites over the past 40 years. However, several complicating factors limit the number of metal analytes to which trend tests can be applied. The first, and most restrictive, of these considerations is the particular fraction, be it dissolved, extractable, or total, of a given metal that was examined. In response to agency changes, enhanced analytical tools, and evolving scientific opinion and knowledge over the years, this may have changed several times for each of the metals under consideration. Unfortunately, due to differing analytical

methodologies for the various fractions, it is often difficult to establish which fractions can reliably be treated as the same entity. Since extractable fractions for most metals are no longer analysed, these data have largely been omitted from the report. An additional consideration for many metals was the proportion of data that fell below method detection limits. Reported as less-thans, non-detects, or 'censored data' (explained below), these data can have a marked influence on trend assessment, particularly if the detection limit varies over time. Hence, those metals demonstrating a high (>40%) incidence of values falling below detection were eliminated from trend analyses. Finally, quality control processes within Alberta Environment have helped identify a number of metals that have historically shown a tendency toward inaccurate or questionable results. Although unfortunate, this is a largely unavoidable phenomenon in the evolution of analytical procedures and equipment. Since detection limits for older analytical methods may differ by several orders of magnitude from those for more recent data, and due to the general incompatibility of data obtained via multiple different methods, results for numerous metals fractions in this report are limited to more recent history or eliminated altogether.

Numerous trace organic compounds, including hydrocarbons, pesticides, chlorinated phenols, resin acids, pharmaceuticals, and a host of other emerging contaminants, have also been monitored at LTRN sites. However, these variables often have a short period of record, are usually only sampled a few times per year, are mostly below detection, and, hence, do not lend themselves to trend assessment. With the exception of some basic summary statistics (Appendix XVIII), data for these variables are not addressed in this report. An inventory of data for all LTRN sites can be accessed through Alberta Environment's online water quality reports at http://environment.alberta.ca/2024.html.

2.2 Statistical Analyses

LTRN data were statistically analysed using the USGS Library for the Analysis of Water Resource Data (Slack & Lorenz 2003, http://water.usgs.gov/software/library.html) in S-Plus (Insightful Corporation). Graphs were prepared with SigmaPlot (SPSS Inc.), while supporting statistical analyses were completed with WQHYDRO (Aroner 1994), a comprehensive software package designed for the assessment of water data.

2.2.1 Step Trends

The step 'trend' – not a true trend in the strictest sense – is one of two primary hypotheses that should be considered in trend estimation. This hypothesis postulates that data collected prior to a specific point in time belong to a distinctly different population (i.e., have a significantly different median value) from data originating after that time (Hirsch *et al.* 1991). The second hypothesis – a monotonic trend – assumes that a data population shifts monotonically (i.e., increases or decreases with no reversal of direction) over time. Since, as indicated in the introduction, the operation of LTRN sites changed hands in 1987, each water quality variable was examined for the potential influence of a step trend in 1987. This was accomplished using a seasonal Wilcoxon-Mann-Whitney test in WQHydro. Previous analyses (Hebben 2005, 2007) have demonstrated that the transfer of monitoring sites from Environment Canada to Alberta Environment resulted in a step trend for several of the variables in question. This unintended upward or downward shift in the median value of a given parameter, if neglected, can a cause a

Type I error during monotonic trend evaluation. In other words, a monotonic trend analysis of data containing a positive step may cause the statistician to reject the null hypothesis (i.e., no monotonic trend in the data over time) and report an increasing trend for a particular variable. This, despite the fact that the presumed trend was simply the product of some overlooked artefact, such as a change in analytical equipment, facilities, or techniques. Hence, in cases where the direction (increasing or decreasing) of a statistically significant monotonic trend coincided with that of a significant step, the monotonic trend results were rejected. For those parameters that exhibited a significant step in 1987, subsequent monotonic trend analyses were performed separately on pre- and post-1987 data.

2.2.2 Seasonality and Autocorrelation

Numerous water quality variables are known to undergo seasonal fluctuations in response to changing environmental conditions, such as ambient temperature, precipitation, or biotic activity, for example. If left unaccounted for, these fluctuations may mask the presence of real trends. Therefore, data for all variables were graphed in seasonal box and whisker plots using the USGS library for S-Plus (Slack & Lorenz 2003). A key to box and whisker plot interpretation is provided in Figure 6. By breaking down data on a monthly (12 'season') basis, these boxplots facilitated visual examination of the data and helped to determine whether or not the seasonal term was included during trend assessment.

A given variable may also be subject to autocorrelation or 'serial correlation', meaning that the measured value for a specific parameter may be dependant on (correlated with) the immediately preceding value in a sampling sequence. For example, if dissolved oxygen concentration in a particular river is low in January, it is likely that a subsequent measurement of dissolved oxygen at the same site in February would also yield a low value. This phenomenon may be a complicating factor during trend assessment. The USGS library for S-Plus (Slack & Lorenz 2003) takes autocorrelation into account by providing both a p-value (significance of the trend) and a corrected p-value (significance of the trend when autocorrelation is taken into account) in trend assessment output. In all instances, the corrected p-value was used in assessing the significance of detected trends.

2.2.3 Censored Data

For many variables, the inability of contemporary instrumentation or analytical techniques to accurately measure a given substance below a certain concentration gives rise to what is referred to as a 'detection limit'. When concentrations fall below the detection limit, data are referred to as 'censored'. Typically reported as being less than the detection limit (e.g., <0.05 μg/L), this type of data can significantly influence trend assessments. To further complicate the issue, changing detection limits over time may also contribute to the generation of step trends. Until recently, the accepted (USEPA 1996) approach to censored data was to convert any value that was below detection to a real number equivalent to half the detection limit. Using this approach, for example, a dissolved iron concentration falling below a detection limit of 0.01 μg/L would be reported as a real value of 0.005 μg/L. Provided that the number of censored values was less than a predetermined proportion of the entire data set (e.g., 50%), these ½ detections were

subsequently used in trend estimates. Unfortunately, statistical results obtained in this manner may not be entirely reliable (Helsel 2006).

For the purposes of this report, censored data were treated as ½ detections only in the determination of basic statistics (minimum, maximum, median, mean, etc.). For the sake of trend assessment, real values equivalent to the appropriate detection limit, but denoted with a less-than (<) symbol, were used. Hence, using the example above, a dissolved iron data point with a concentration falling below the detection limit of 0.01 µg/L would be entered into trend assessments as <0.01 µg/L. As explained below, the USGS library for S-Plus (Slack & Lorenz 2003) is equipped to deal with both censored and uncensored data in performing trend assessments. Hence, this obviated the need for ½ detections.

2.2.4 Flow Adjustment

Stream flow has the ability to modify the outcome of trend analyses. During high-flow years, typically the result of high precipitation, certain products of non-point source runoff/overland flow (e.g., phosphorus) may appear in greater concentrations than they would during lower flows. Conversely, during periods of low flow, the impacts of point source effluents (such as those originating at wastewater treatment plants) may be amplified, since the reduced volume of water in a given stream will lead to less dilution of the effluent in question. Hence, in a hypothetical scenario, if stream flow were to show a significantly decreasing trend over a period of ten years, a specific component of the aforementioned effluent (e.g., nitrogen), despite having experienced similar inputs every year during those ten years, may end up demonstrating a significantly increasing trend. Flow-dependent changes may or may not be of interest, depending on the needs of the user. Therefore, the ensuing report addresses trends in both raw data and flow-adjusted data. Flow adjustment for each water quality variable was accomplished via the USGS library for S-Plus (Slack & Lorenz 2003), which can evaluate a series of regression equations to determine which one is most effective in describing the correlation between flow and a given variable. The selected equation is then used to adjust the data and facilitate subsequent trend assessment on flow-adjusted residuals. For the purposes of this report, flow values used for trend assessment at the Hinton LTRN site were based on daily means reported by the Water Survey of Canada (WSC; http://www.wsc.ec.gc.ca/hydat/H2O) for their Hinton hydrometric station (#07AD002). Flow values used for trend assessment at the Old Fort LTRN site were based on daily means reported for the WSC station at Fort McMurray (#07DD011).

A few additional points should be noted, with regard to the use and examination of stream flow data in this report. Most importantly, statistical manipulations of flow data for comparison to water quality data were first performed on daily means *corresponding to monthly water quality sampling dates*. Although the WSC provides daily means for all the days in a year, statistical examination of water quality data required that flow data be limited to those days on which water quality parameters were sampled (i.e., one data point per month, 12 data points per year). Hence any trends reported for this limited dataset do not necessarily reflect actual trends that may be present in the full dataset. To account for any misrepresentation of flow trends arising from the use of a partial dataset, trend assessment was subsequently performed on the full set of daily means from 1961 through 2007. This time frame was selected for two reasons. Firstly, the

hydrometric station at Hinton became operational in 1961. To facilitate comparison between sites, data analysis for the other two hydrometric stations (Athabasca, Fort McMurray) was restricted to the same start year, despite the fact that records for both stations extend farther back. Secondly, for the sake of consistency, it was deemed important to incorporate only flow information over *the period of water quality sampling*. Hence, any identified trends are representative of the 1961-2007 period and do not necessarily reflect trends in the full available dataset.

2.2.5 Monotonic Trends

The monotonic trend hypothesis, as noted previously, assumes that the median of a dataset increases or decreases, with no reversal of direction, over time. If significant, the results of a monotonic trend test can be very useful in assessing the state of water quality in a river. For example, a significant downward trend in phosphorus concentration over time (reported for some Alberta rivers; Hebben 2005, 2007) might suggest that upgrades to a wastewater treatment plant have helped reduce the amount of nutrients entering a river. Conversely, a significant downward trend in dissolved oxygen concentration might be indicative of deteriorating water quality conditions, which could make the riverine environment less hospitable to aquatic organisms.

In this report, the type of trend assessment used and how it was applied were contingent upon several factors, most of which are detailed above. The steps described below (and outlined in Figure 7) assume that the variable under investigation had at least 10 years' worth of continuous data (with a small number of exceptions) and no more than 40% censored data. Note that all trend analyses mentioned here were rerun using flow-adjusted data. Initially, complete data sets (1960-2008) for all water quality variables were imported into WQHydro for step trend analysis using a seasonal Wilcoxon-Mann-Whitney test. The purpose of this analysis, designed to compare medians in the data prior to and after 1987 (the point of agency change), was to establish whether or not a significant step existed in the data and might be driving the results of subsequent monotonic trend tests. Data were then subjected to monotonic trend assessments using the USGS library for S-Plus (Slack & Lorenz 2003). Parameters with uncensored data were tested using an uncensored seasonal Kendall analysis, while those with censored values were generally examined using a Tobit regression (on log-transformed data), which assumes that data are censored above or below certain values. A small number of metals with relatively low (<12%) censorship did not lend themselves to Tobit analysis and were examined for monotonic trends using a censored seasonal Kendall analysis. In situations where the direction of a significant monotonic trend coincided with that of a significant step, the overall (1966-2005) monotonic trend results were rejected. For example, if dissolved sodium demonstrated a positive overall trend and a positive step in 1987, the overall trend was essentially negated. In all instances where monotonic trend and step analyses yielded significant results in the same direction (positive or negative), data were subsequently subdivided into two separate sets (pre- and post-1987). Monotonic trend analyses were then rerun on the resulting smaller data sets.

2.3 Comparison to Water Quality Guidelines

Water quality data examined for the purposes of this report were compared to surface water quality guidelines for use in Alberta (AENV 1999a) and more recent updates from the Canadian

Council of Ministers of the Environment (CCME 2003 and updates). Guidelines selected for comparison were the more stringent of those available for protection of aquatic life (PAL), recreation, or agricultural use.

3.0 RESULTS AND DISCUSSION

Basic descriptive statistics for all routinely monitored variables are listed in Tables 2-4. Due to the presence of step trends for several variables, descriptive statistics are presented both for the entire sampling frame (1960-2008) and for post-1987 data. Trend and seasonality graphs for most analysed variables are depicted in Figures 12 through 251. Seasonality boxplots are explained in Figure 10. In several instances (e.g., basic statistics, sampling frequency graphs, guideline exceedance tables), results are depicted in geographical sequence (i.e., upstream – downstream). Time series graphs and seasonality boxplots, however, are grouped according to data availability. Hence, the focus is on those sites with adequate data for trend assessment (Athabasca, Old Fort), while sites with less extensive datasets (Hinton, Fort McMurray) occur together. For various reasons, including brief records, poor data quality, and high frequency of censored data, some parameters are not displayed in graphical format. Raw results of statistical analyses can be viewed in the appendices. Throughout the report, the term 'routine variables' is used in reference to physical characteristics (e.g. pH, temperature), ions, nutrients, biotic variables, and certain routinely sampled constituents (Table 1), while the term 'metals' refers to metals, a handful of nonmetals (arsenic, boron, and selenium), and cyanide (Table 1). Summary statistics for trace organic contaminants at the four LTRN sites are compiled in Appendix XVIII.

3.1 Athabasca Routine Variables, Trends

3.1.1 1960-2008

Long term trend assessment of routine variables at the Athabasca sampling station identified nine parameters that have undergone significant trends during the period of record (Table 5). However, all of these trends coincided with significant steps in the data, suggesting that a change in sampling agency, as explained previously, may have contributed to the identification of significant monotonic trends. Since a significant step in the same direction as the monotonic trend negates the latter, the nine identified monotonic trends over the period of record must be rejected and the data re-evaluated on a pre-1987 and post-1987 basis.

Monotonic trend assessment of Water Survey of Canada stream flow data collected at the Athabasca station on water quality sampling dates did not yield any significant trends (Table 5, Figure 12). However, a similar examination of all daily means over the entire duration of water quality sampling (1957-2008) did return a significant negative, or decreasing, trend (Figure 248).

After water quality data were adjusted to account for the potential influence of flow on various parameters, eight variables demonstrated significant monotonic trends at the Athabasca sampling site (Table 5) over the period of record. Of these trends, however, only two did not coincide with a 1987 step in the data. Turbidity (Figure 38) and total phosphorus (Figure 116) both exhibited increasing trends in flow adjusted data over the period of record.

3.1.3 Pre-1987

Prior to 1987, raw data for five variables described significant monotonic trends (Table 5). Three of these, including temperature (Figure 14), hardness (Figure 30), and sulphate concentration (Figure 84) were negative, or decreasing, from 1960 to 1987. The remaining two, namely turbidity (Figure 38) and non-filterable residue (Figure 42), exhibited positive, or increasing, trends before 1987.

Subsequent to flow adjustment, five parameters exhibited significant trends in pre-1987 data (Table 5). Of these, temperature (Figure 14), magnesium concentration (Figure 66), and sulphate concentration (Figure 84) were decreasing, while dissolved sodium (Figure 58) and nitrite + nitrate nitrogen (Figure 108) concentrations were increasing.

3.1.4 Post-1987

In instances where a significant overall monotonic trend (1960-2008) for a given water quality variable may have been influenced by a significant step in 1987, monotonic trends in post-1987 data, as a reflection of recent tendencies, were generally approached as the most meaningful trend information that could be obtained from the dataset. At the Athabasca sampling site (Table 5), five routine water quality variables described significant post-1987 trends. Filterable residue (Figure 50), dissolved sodium (Figure 58), sulphate (Figure 84), and total ammonia nitrogen (Figure 100) all demonstrated significant increasing tendencies after 1987, while turbidity data (Figure 38) underwent a significant downward trend in the same time frame.

Following adjustment to account for stream flow, filterable residue (Figure 50), sodium (Figure 58), and sulphate (Figure 84) retained significant upward tendencies in post-1987 data, while turbidity (Figure 38) continued to describe a significant decline. Total ammonia nitrogen (Figure 100) no longer reported a trend after flow adjustment, while dissolved chloride (Figure 76) and total Kjeldahl nitrogen (Figure 104) assumed a significant downward tendency in flow adjusted residuals.

3.2 Athabasca Metals, Trends

For a variety of reasons, AENV datasets for metals are highly complex. Over the years, different fractions (i.e. dissolved, extractable, total) may have been analysed for any given metal (Figure 6-9). Some of these, such as the extractable fraction for most metals, may no longer be subject to analysis. Furthermore, detection limits may have changed multiple times since sampling began. In some instances, a given metal may have been rarely detected, giving rise to a high frequency of non-detects/censored values, which can represent a substantial barrier to trend assessment. In other cases, analytical methods (in conjunction with associated detection limits) may have changed considerably from one period to the next, leading to data that may fluctuate quite markedly and are not readily comparable over time. As a result of these complicating factors, the vast majority of AENV metals data for the Athabasca River are not amenable to trend assessment at this time. However, due to the ongoing nature of LTRN sampling, continuous improvement in analytical techniques, as well as enhanced accuracy of analytical results, these data will largely be appropriate for trend analysis within the next few years.

Despite the various limitations of the dataset, data for a handful of metal fractions were sufficient at the Athabasca sampling location to facilitate the trend assessment process (Table 6). Of these, only total aluminum (Figure 142) underwent a trend, demonstrating a significant increasing tendency between 1987 and 2008.

3.3 Athabasca, Guideline Comparison

When assessing water quality guideline exceedances in aquatic systems, it is important to bear in mind that these guidelines are intended for application across a broad range of natural and geographic regions, climate zones, surficial geology, and soil types. Hence, they may not take into account the potential for naturally high background levels of certain variables in freshwater systems. For example, many lakes in Central Alberta are high in sediment and water column phosphorus, due in large part to natural sources, such as glacial till. Concentrations of total phosphorus may, in fact, exceed the ASWQ guideline of 0.05 mg/L. Although human activity may also contribute to phosphorus concentrations in these systems, it can be challenging to establish what proportion is attributable to natural background and how much is due to anthropogenic disturbance. Similarly, the lower Athabasca River and its tributaries demonstrate naturally high values and frequent guideline exceedances for certain parameters that are associated with high sediment loads (e.g., total iron, total aluminum, total phosphorus), which may not necessarily be detrimental to aquatic biota that has evolved under these conditions. This is not to say that human activities in the watershed do not contribute to exceedances, but a need for caution in interpretation is indicated.

Measured values for routine water quality variables largely conformed to guidelines at the Athabasca sampling location (Tables 5, 9). With a few exceptions, most variables were 98-100 percent consistent with available guidelines. These exceptions included; total coliform bacteria, which were found to exceed the guideline 3.6% of the time; total nitrogen, which was non-compliant 5.2% of the time; and total phosphorus, which was higher than the 0.05 mg/L guideline 31% of the time.

Exceedances of metals guidelines at the Athabasca sampling location tended to occur more frequently than did guideline exceedances for routine variables (Tables 6, 10). Most notably, the CCME guideline of 0.3 mg/L for total iron was exceeded 57.5% of the time, while the 0.1 mg/L guideline for total aluminum was exceeded 50.6 % of the time. The hardness-based total cadmium guideline was exceeded in 47.4% of samples. Similarly, total copper was in excess of its hardness-based guideline in 42.4% of samples. Total lead concentrations at Athabasca exceeded hardness-based guidelines in 13.1% of samples, while zinc values were higher than the 0.3 mg/L guideline in 12.7% of samples. Hexavalent chromium exceeded the CCME guideline (0.001 mg/L) in two of 18 samples. All other metals remained below their respective guidelines 94-100% of the time, translating to no more than one exceedance for any of arsenic, molybdenum, nickel, selenium, silver, and thallium.

3.4 Old Fort Routine Variables, Trends

3.4.1 1977-2008

Relatively few variables were sampled at the Old Fort station prior to 1987. Hence, most trend assessments for this sampling site fall into the post-1987 section (Table 7). Of the variables for which data were collected prior to 1987, only stream flow demonstrated a significant trend, decreasing over the period in question (Table 7, Figure 12). It is important to note that flow data used for this assessment were collected at the Fort McMurray gauging station (upstream of Old Fort). Although tributary contributions between the two sites are quite small relative to overall flow in the Athabasca River, it is likely that some small discrepancy will exist between measured flows at Fort McMurray and actual flows at Old Fort. For the sake of subsequent flow adjustment on other variables, daily mean flows used in this analysis corresponded to sampling dates at the Old Fort station. Trend analysis on a more comprehensive set of all available daily mean flows (1957-2008) at the Fort McMurray station also yielded a downward tendency (Figure 249).

Several variables did appear to be affected by the 1987 change in sampling agencies (Table 8). Four variables, including specific conductance (Figure 22), sodium (Figure 58), chloride (Figure 76), and sulphate (Figure 84), demonstrated significant upward steps in 1987. An additional four variables, including non-filterable residue (Figure 42), dissolved organic carbon (Figure 96), nitrite and nitrate nitrogen (Figure 108), and total nitrogen (Figure 112), underwent significant downward steps in 1987.

After data were adjusted to account for the potential masking effect of stream flow, six variables described significant monotonic trends over the entire sampling period (Table 7). Of these, specific conductance (Figure 22), hardness (Figure 30), calcium (Figure 62), and chloride (Figure 76) were decreasing, while non-filterable residue (Figure 42) and total phosphorus (Figure 116) were increasing. Changes in chloride concentrations at Old Fort may be influenced by the Clearwater River, which is naturally high in chloride (Noton & Saffran 1995). Increasing total phosphorus, on the other hand, may be related to both pulp mill effluents (North-South 2007) and a rapidly growing human population with a corresponding increase in wastewater treatment plant effluents (Noton & Shaw 1989).

3.4.3 Pre-1987

With the exception of pH, variables monitored at the Old Fort site did not possess data of adequate temporal coverage and sampling frequency for monotonic trend assessment prior to 1987. During this period, pH did not undergo any significant trends (Table 7, Figure 18).

3.4.4 Post-1987

In the period following the change in monitoring agencies, seven variables demonstrated significant monotonic trends at the Old Fort sampling site (Table 7). Turbidity (Figure 38), non-filterable residue (Figure 42), pH (Figure 18), nitrite and nitrate nitrogen (Figure 108), and total ammonia nitrogen (Figure 100) described increasing tendencies between 1987 and 2008, while

temperature (Figure 14) and total coliform bacteria (Figure 128) decreased over the same time frame. Simultaneous increases in turbidity and non-filterable residue, while not immediately explicable, serve to enhance confidence in trend results, since the two variables are different measures of the same condition. Similarly, an increase in pH, also without explanation at this time, is corroborated by Environment Canada results (Nancy Glozier, pers. comm.) for a sampling station in relative proximity to the Old Fort site. Decreasing trends in water temperature data, although somewhat counterintuitive, appear to be a recurring phenomenon for Alberta rivers (Hebben 2005, 2007) and should be investigated more closely.

3.5 Old Fort Metals, Trends

Data for eight metals fractions at the Old Fort monitoring site were of adequate temporal coverage, sampling frequency, and quality to facilitate monotonic trend assessment (Table 8). For reasons explained previously, all of these were limited to the post-1987 period. During this time frame, total aluminum (Figure 142) described a significant increasing trend, while total copper (Figure 178) and total molybdenum (Figure 201) underwent decreasing trends. This is somewhat contrary to previous findings (Hatfield 2006), which suggest that neither total aluminum nor total molybdenum has changed over time, and may be a function of the statistical analyses applied. Following adjustment to account for the influence of stream flow, only total aluminum (Figure 142) and total arsenic (Figure 147) showed significant trends, both of which were increasing.

Raw data for both total and dissolved arsenic at the Old Fort sampling station do not exhibit significant trends over time. When adjusted for flow, however, data for total arsenic demonstrate a significant increasing trend. Bearing in mind that flow itself has undergone a decreasing trend over time, while non-filterable residue (NFR; = total suspended solids) and turbidity have shown increasing tendencies in both raw and flow adjusted data, this is not entirely surprising. In conjunction with an upward trend in total aluminum, these factors are indicative of increasing sediment concentration in the river. Significant proportions of aluminum and arsenic in rivers are typically associated with sediment particles, particularly clay and silt fractions. Hence, as might be anticipated, total arsenic concentration in the Athabasca River at Old Fort demonstrates a fairly strong correlation with NFR ($R^2 = 0.675$, $p<<0.001$). It is not clear, however, to what extent the trend in total arsenic is related to changes in flow composition (i.e., glacial melt vs. surficial runoff vs. groundwater), anthropogenic influences, or a combination thereof. To help address this question, sampling frequency for metals at the two LTRN sites on the lower Athabasca River will be reviewed. Moreover, arsenic will be more thoroughly investigated as part of Alberta Environment's upcoming comprehensive contaminant load study. Finally, it is important to note that arsenic data in the Athabasca River have not exceeded the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (5 µg/L) in the period of reliable data (post-1994) and have been well within the CCME drinking water guideline (10 µg/L) during the same time frame.

3.6 Old Fort, Guideline Comparison

Guideline exceedances for routine variables at the Old Fort sampling site are relatively infrequent, with between 98 and 100% adherence for most guidelines (Table 9). Exceptions

include total phosphorus (46.2% exceedance) and total nitrogen (11.2% exceedance). Not surprisingly, both of these variables demonstrate increasing frequency of guideline exceedance from upstream to downstream monitoring sites (Table 9).

As was the case at the Athabasca monitoring station, guideline exceedances at the Old Fort site were generally more frequent for metal variables than they were for routine variables (Table 10). Several parameters, including total arsenic, total molybdenum, total nickel, and total selenium, consistently remained below guidelines. Total silver exceeded the CCME guideline of 0.0001 mg/L once, while total zinc exceeded the guideline (0.03 mg/L) five times, and total lead exceeded the hardness-based guideline nine times. More dramatic guideline exceedances were evidenced by hexavalent chromium (36.8% of samples), total copper (56.1% of samples), total aluminum (62.5% of samples), total cadmium (70% of samples), and total iron (96.2% of samples). As indicated previously, many of these guideline exceedances are likely linked to naturally high suspended sediments in the lower Athabasca River and its tributaries (North-South 2007). At the same time, however, anthropogenic contributions from both point- (wastewater treatment plant effluents, pulp mill effluents) and non-point sources (resource extraction, forestry, agriculture,) cannot be ruled out.

4.0 CONCLUSION

Statistical trend assessment of water quality variables monitored in the Athabasca River at Athabasca and Old Fort since 1960 has identified the existence of several significant monotonic trends at both monitoring stations. Some of these appear to be driven by a step in the data, associated with a 1987 transition in monitoring agencies, and have been rejected on that basis. Others are statistically defensible. Taking into account the influence of the aforementioned step, the most notable declining monotonic trends at the Athabasca site are those in turbidity, chloride (flow adjusted data), and total Kjeldahl nitrogen (flow adjusted data). Increasing trends of note at the Athabasca monitoring station, again with a focus on relevant overall and post-1987 trends, are those for nitrite and nitrate nitrogen (flow adjusted data), sodium, sulphate, total ammonia nitrogen, total phosphorus, and total aluminum. Although assessment of stream flow values corresponding to actual water quality sampling dates did not yield a significant monotonic trend, subsequent analysis of all available daily mean flows at the Athabasca site over the period of interest (~1960-2008) resulted in a significant declining trend. This downward tendency may help to explain at least some of the trends, both decreasing and increasing, in raw (unadjusted) data for parameters listed above.

Trend analysis of water quality variables at the Old Fort sampling station identified several trends in both overall data and post-1987 data. Decreasing tendencies were reported for flow (both on sampling dates and for the complete dataset), water temperature, conductivity (flow adjusted data), hardness, calcium, chloride, total coliform bacteria, total copper, and total molybdenum. Significantly increasing monotonic trends were noted for pH, turbidity, non-filterable residue (NFR), total ammonia nitrogen, nitrate and nitrite nitrogen, total phosphorus, total aluminum, and total arsenic. Since many of these variables, namely nutrients and metals, can be closely linked to turbidity and NFR in a river, it is not surprising to see simultaneous increases of this nature. However, reasons for these upward trends are unclear at this time. Some may potentially be related to the downward trend in stream flow, which would lead to decreased dilution capacity and increased concentrations of the constituents of point source effluents (e.g., municipal wastewater treatment plants, pulp mills). In addition, many of these trends may be linked to basin development and anthropogenic disturbance in the watershed. Agriculture, forestry, and resource extraction activities, for example, could contribute to higher levels of nutrients and metals in non-point source runoff.

Guideline exceedances in the Athabasca River are fairly common for several parameters, most of which are nutrients and metals. However, since many of the available guidelines were developed based on a fairly specific suite of ecosystem types, this may speak more to the limitations of existing guidelines than any immediate issues in the Athabasca River – relative to the specific suite of parameters examined herein. Based on chronic exceedances for variables such as phosphorus, iron, aluminum, and cadmium, a potential need for site-specific guidelines is indicated.

As noted in the introduction, the purpose of this report was to conduct a thorough trend analysis of Athabasca River water quality data for those variables and those sites with adequate data for such an exercise. The intent was not to investigate each individual trend for potential causes, as this would require extensive evaluations beyond the scope of this report. However, it is

recommended that the trends identified herein be carefully examined and, where necessary, considered for additional, more thorough investigation. Moreover, it should be reiterated that, as part of the ongoing LTRN program, water quality data continue to accumulate on a monthly basis for the monitoring stations at Hinton and Fort McMurray. Within the next five to ten years, sufficient data will have been acquired to initiate a similar trend assessment for these sampling sites. Completion of such an analysis, in conjunction with a parallel update to the current document may help elucidate the causes of any identified trends and provide a more comprehensive understanding of the state of the Athabasca River.

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Table 1 Core water quality variables sampled as part of Long-Term River Network monitoring on Athabasca River since 1960. Year ranges reflect sampling at the oldest LTRN site (Athabasca) and are not representative of all LTRN sites on the Athabasca River.

Routine Variables	Years of Record	Units
Temperature	1960-2008	°C
pH	1960-2008	
Specific Conductance	1960-2008	μS/cm
Total Alkalinity	1960-2008	mg/L $CaCO_3$
Hardness	1960-2008	mg/L $CaCO_3$
DO	1960-2008	mg/L CaCO3
Turbidity (JTU)	1960-1987	JTU
Turbidity (NTU)	1987-2008	NTU
Apparent Colour	1960-1981	Relative Units
	1987	
True Colour	1981-1987	Relative Units
	1988-2008	
Non-Filterable Residue	1960-1973	mg/L
	1977-2008	
Total Dissolved Solids	1982	mg/L
	1985-1986	
	1996-2008	
Filterable Residue	1960-1967	mg/L
	1987-2008	
Potassium	1960-2008	mg/L
Sodium	1960-2008	mg/L
Calcium	1960-2008	mg/L
Magnesium	1960-1969	mg/L
	1975-2008	
Bicarbonate	1982	mg/L
	1985-2008	
Carbonate	1985-2008	mg/L
Chloride	1960-2008	mg/L
Sulphate	1960-2008	mg/L
Fluoride	1960-2008	mg/L
Reactive Silica	1960-2008	mg/L
Total Organic Carbon	1971-2007	mg/L
Particulate Organic Carbon	1978-1996	mg/L
Dissolved Organic Carbon	1977-2008	mg/L
Particulate Nitrogen	1978-1996	mg/L
Dissolved Nitrogen	1978-1987	mg/L
Dissolved Kjeldahl Nitrogen	1987-1996	mg/L
Total Kjeldahl Nitrogen	1973-1978	mg/L
	1987-2008	
Nitrite and Nitrate	1965-2008	mg/L
Total Nitrogen	1973-2005	mg/L
Nitrate	1960-1965	mg/L
	1999-2008	
Nitrite	1999-2008	mg/L
Total Phosphorus	1973-2008	mg/L
Total Dissolved Phosphorus	1978-2008	mg/L
Chlorophyll a	1973	mg/L
	1980-2008	
Total Coliform Bacteria	1977-1999	cells/100 mL
Fecal Coliform Bacteria	1977-2008	cells/100 mL
Fecal Streptococcal Bacteria	1977-1996	cells/100 mL
Escherichia coli	1999-2008	cells/100 mL

Metals*	Years of Record	Units
Aluminum	1960-1967	mg/L
	1971-1980	
	1988-2008	
Arsenic	1971-2008	mg/L
Barium	1971-1980	mg/L
	1983-2008	
Beryllium	1994-2008	mg/L
Boron	1973-2008	mg/L
Cadmium	1971-1979	mg/L
	1983-2008	
Chromium	1971-1980	mg/L
	1994-2008	
Cobalt	1971-1980	mg/L
	1983-2008	
Copper	1960-1962	mg/L
	1967-1980	
	1983-2008	
Cyanide	1974-1977	mg/L
	1999-2006	
Iron	1960-2008	mg/L
Lead	1967-1980	mg/L
	1983-2008	
Lithium	1971-1973	mg/L
	1978-1980	
	1999-2008	
Manganese	1960-2008	mg/L
Mercury	1973-2008	mg/L
Molybdenum	1971-1980	mg/L
	1994-2008	
Nickel	1971-1980	mg/L
	1983-2008	
Selenium	1974-2008	mg/L
Silver	1971-1974	mg/L
	1978-1994	
	1997-2008	
Strontium	1971-1980	mg/L
	1999-2008	
Thallium	1971-1973	mg/L
	1999-2008	
Titanium	1999-2008	mg/L
Uranium	1996-2008	mg/L
Vanadium	1971-1973	mg/L
	1976-1980	
	1983-2008	
Zinc	1960-1962	mg/L
	1967-1980	
	1983-2008	
Zirconium	1999-2003	mg/L

*Years of record incorporate all fractions for each particular variable.

Table 2 Summary statistics for routine water quality variables in the Athabasca River at the Hinton and Athabasca sampling stations for the period **1957-2007**.

	Flow (m^3/s)	Temperature (°C)	pH	Conductivity (µS/cm)	Alkalinity (mg $CaCO_3$/L)	Hardness (mg $CaCO_3$/L)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Non-Filterable Residue (mg/L)	Total Dissolved Solids (mg/L)	Filterable Residue (mg/L)	Dissolved Potassium (mg/L)	Dissolved Sodium (mg/L)
Hinton													
Minimum	-	-0.32	6.96	158.0	69.5	85.00	8.71	0.6	0.5	94.5	56.0	0.2	0.3
First Quartile	-	-0.01	7.90	221.8	84.4	112.50	10.08	6.0	10.0	124.0	136.0	0.4	1.0
Mean	-	5.40	8.00	314.5	106.9	164.03	11.08	29.8	38.0	187.3	193.4	0.5	1.8
Median	-	4.66	8.03	318.5	109.5	170.00	11.33	14.1	18.5	190.0	196.0	0.5	1.8
Third Quartile	-	10.02	8.14	399.8	127.8	210.00	12.00	29.9	38.3	240.8	244.0	0.6	2.4
Maximum	-	16.54	8.87	682.0	237.0	360.00	13.43	400.0	536.0	412.0	482.0	1.4	5.5
n	-	101	102	102	102	102	101	102	102	102	101	102	102
Standard Deviation	-	5.39	0.25	96.3	25.6	51.75	1.19	50.1	67.3	62.0	67.7	0.2	0.9
Standard Error	-	0.54	0.02	9.5	2.5	5.12	0.12	5.0	6.7	6.1	6.7	0.0	0.1
Begin Year	-	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999
End Year	-	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	-	-	-	-	-	-	-	-	3	-	-	15	4
Athabasca													
Minimum	42	-0.40	6.18	117.0	39.0	55.86	5.80	0.1	0.2	107.0	94.9	0.4	2.2
First Quartile	111.5	0.23	7.70	233.3	101.3	112.00	8.86	2.9	2.0	132.0	148.0	1.0	5.3
Mean	421.317	7.12	7.92	312.5	130.8	147.52	10.30	34.8	69.8	183.6	198.8	1.5	9.4
Median	269	3.66	7.92	292.0	125.0	140.00	9.90	7.3	12.0	167.0	190.0	1.3	8.5
Third Quartile	613	14.40	8.10	389.8	159.0	182.43	11.68	40.7	68.7	229.0	245.0	1.7	12.0
Maximum	2730	23.00	10.10	528.0	222.0	249.60	15.80	1100.0	1680.0	310.0	388.0	18.0	31.5
n	583	514	550	518	522	521	439	519	394	173	269	519	520
Standard Deviation	400.258	7.42	0.34	87.5	33.2	39.50	1.79	73.5	158.7	58.6	59.1	1.1	5.0
Standard Error	16.7503	0.33	0.01	3.8	1.5	1.73	0.09	3.2	8.0	4.5	3.6	0.0	0.2
Begin Year	1957	1957	1957	1960	1957	1960	1957	1957	1957	1982	1957	1960	1960
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	-	-	-	-	-	-	-	-	33	-	-	-	-

Table 2 Summary statistics for routine water quality variables in the Athabasca River at the Fort McMurray and Old Fort sampling stations for the period **1957-2007** (continued).

	Flow (m^3/s)	Temperature (°C)	pH	Conductivity (µS/cm)	Alkalinity (mg $CaCO_3$/L)	Hardness (mg $CaCO_3$/L)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Non-Filterable Residue (mg/L)	Total Dissolved Solids (mg/L)	Filterable Residue (mg/L)	Dissolved Potassium (mg/L)	Dissolved Sodium (mg/L)
Fort McMurray													
Minimum	-	-0.24	7.21	183.0	77.6	85.00	7.97	1.4	0.5	110.0	107.0	0.2	5.6
First Quartile	-	-0.04	7.86	242.8	104.8	110.00	9.60	3.4	2.0	141.8	161.5	1.1	9.0
Mean	-	8.05	8.07	331.7	135.6	144.75	11.50	53.2	68.6	195.4	213.2	1.7	15.4
Median	-	6.77	8.14	291.0	123.5	130.00	11.57	9.2	9.5	170.0	194.0	1.5	14.3
Third Quartile	-	15.74	8.29	435.3	171.5	180.00	13.25	55.7	63.0	251.8	264.8	2.1	19.9
Maximum	-	24.73	8.80	670.0	269.0	300.00	14.93	856.0	780.0	414.0	450.0	4.9	39.6
n	-	61	65	64	64	64	64	64	64	64	64	64	64
Standard Deviation	-	8.23	0.34	107.5	39.8	44.60	1.93	123.8	146.8	67.2	68.9	0.9	7.9
Standard Error	-	1.05	0.04	13.4	5.0	5.58	0.24	15.5	18.3	8.4	8.6	0.1	1.0
Begin Year	-	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002
End Year	-	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	-	-	-	-	-	-	-	-	11	-	-	1	-
Old Fort													
Minimum	91.00	-0.30	6.41	165.0	65.1	66.60	5.90	1.5	0.2	102.0	70.0	0.1	4.6
First Quartile	181.00	0.00	7.54	236.0	94.0	100.00	8.86	6.0	4.9	129.0	151.0	1.0	10.4
Mean	576.43	7.20	7.72	334.2	117.1	126.45	10.06	48.3	72.6	183.4	201.9	1.3	21.0
Median	399.00	4.00	7.73	309.5	112.5	122.00	9.94	14.8	22.0	164.0	190.0	1.3	18.3
Third Quartile	828.00	14.40	7.90	415.0	139.0	150.00	11.12	58.5	85.2	230.0	253.0	1.6	29.1
Maximum	2540.00	23.50	8.70	721.0	242.0	262.24	14.29	1290.0	1096.0	342.0	450.0	8.2	55.0
n	336	214	276	252	272	271	202	245	270	137	257	267	272
Standard Deviation	504.77	7.83	0.34	108.2	27.5	30.78	1.62	98.9	126.8	61.3	62.9	0.7	11.9
Standard Error	28.00	0.54	0.02	6.8	1.7	1.87	0.11	6.3	7.7	5.2	3.9	0.0	0.7
Begin Year	1968	1968	1968	1977	1977	1977	1968	1977	1977	1984	1977	1977	1977
End Year	2007	2007	2007	2007	2007	2007	2007	2077	2007	2007	2007	2007	2007
Censored Values	-	-	-	-	-	-	-	-	4	-	-	1	-

Table 2 Summary statistics for routine water quality variables in the Athabasca River at the Hinton and Athabasca sampling stations for the period **1957-2007** (continued).

	Dissolved Calcium (mg/L)	Dissolved Magnesium (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulphate (mg/L)	Silica (mg/L)	Total Organic Carbon (mg/L)	Dissolved Organic Carbon (mg/L)	Particulate Nitrogen (mg/L)	Dissolved Nitrogen (mg/L)
Hinton												
Minimum	23.5	6.3	84.90	0.25	0.2	0.025	20.2	2.21	0.10	0.10	-	-
First Quartile	30.2	9.0	102.50	0.25	0.3	0.090	31.6	3.10	0.60	0.50	-	-
Mean	43.5	13.5	130.44	0.25	0.8	0.113	61.5	3.49	0.87	0.77	-	-
Median	43.9	14.0	133.50	0.25	0.8	0.120	63.0	3.60	0.80	0.60	-	-
Third Quartile	55.3	17.1	155.50	0.25	1.1	0.140	87.5	3.88	1.10	1.00	-	-
Maximum	95.9	29.5	289.00	0.25	3.7	0.210	136.0	4.48	2.20	3.60	-	-
n	102	102	102	102	102	101	102	29	29	101	-	-
Standard Deviation	13.4	4.5	31.21	0.00	0.6	0.04	28.3	0.67	0.46	0.55	-	-
Standard Error	1.3	0.4	3.09	0.00	0.1	0.00	2.8	0.12	0.08	0.05	-	-
Begin Year	1999	1999	1999	1999	1999	1999	1999	1999	1999	1999	-	-
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2006	2007	-	-
Censored Values	-	-	-	103	25	3	-	-	1	5	-	-
Athabasca												
Minimum	16.6	3.5	92.40	0.00	0.2	0.025	8.0	0.25	1.40	1.30	0.01	0.09
First Quartile	31.9	8.2	124.23	0.25	1.4	0.083	19.6	3.90	5.60	4.90	0.04	0.17
Mean	41.2	11.0	163.45	0.30	3.1	0.117	30.9	4.75	7.88	6.53	0.16	0.27
Median	38.9	10.4	151.10	0.25	2.4	0.110	27.6	4.80	6.82	6.10	0.08	0.26
Third Quartile	50.0	13.5	203.70	0.25	4.5	0.130	40.0	5.60	9.00	7.80	0.21	0.32
Maximum	68.0	19.5	271.00	4.80	11.3	1.120	71.1	9.40	28.00	25.10	1.10	2.30
n	519	454	272	268	523	421	520	446	301	345	200	104
Standard Deviation	10.7	3.2	43.43	0.48	2.0	0.081	13.5	1.27	3.96	2.91	0.20	0.23
Standard Error	0.5	0.2	2.63	0.03	0.1	0.004	0.6	0.06	0.23	0.16	0.01	0.02
Begin Year	1960	1960	1982	1982	1984	1960	1960	1960	1969	1977	1978	1978
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	1996	1987
Censored Values	-	-	-	227	1	7	-	-	-	-	-	-

Table 2 Summary statistics for routine water quality variables in the Athabasca River at the Fort McMurray and Old Fort sampling stations for the period **1957-2007** (continued).

	Dissolved Calcium (mg/L)	Dissolved Magnesium (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulphate (mg/L)	Silica (mg/L)	Total Organic Carbon (mg/L)	Dissolved Organic Carbon (mg/L)	Particulate Nitrogen (mg/L)	Dissolved Nitrogen (mg/L)
Fort McMurray												
Minimum	24.4	5.7	94.60	0.25	0.3	0.025	15.1	0.82	4.00	3.90	-	-
First Quartile	30.6	8.3	127.75	0.25	2.2	0.090	23.7	3.57	7.33	6.70	-	-
Mean	40.2	10.9	165.29	0.43	4.0	0.127	38.6	4.54	9.35	8.36	-	-
Median	36.1	9.7	151.00	0.25	3.6	0.110	33.3	4.39	8.10	7.80	-	-
Third Quartile	50.5	13.4	208.25	0.50	5.3	0.130	53.3	5.75	11.05	10.00	-	-
Maximum	81.0	22.9	329.00	3.50	12.0	1.200	93.5	8.05	19.60	18.10	-	-
n	64	64	64	64	63	63	63	33	34	63	-	-
Standard Deviation	12.4	3.3	48.52	0.43	2.3	0.140	18.4	1.74	3.43	2.82	-	-
Standard Error	1.5	0.4	6.06	0.05	0.3	0.018	2.3	0.30	0.59	0.36	-	-
Begin Year	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	-	-
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	-	-
Censored Values	-	-	-	62	-	1	-	-	-	-	-	-
Old Fort												
Minimum	19.1	4.0	79.30	0.00	1.2	0.025	8.5	2.65	3.50	2.90	0.01	-
First Quartile	28.0	7.4	114.00	0.25	7.7	0.100	18.0	4.80	7.08	6.90	0.04	-
Mean	34.9	9.6	142.30	0.29	20.1	0.126	25.9	6.48	9.70	9.17	0.15	-
Median	33.7	9.4	138.00	0.25	16.1	0.120	24.7	5.84	8.70	8.45	0.08	-
Third Quartile	41.2	11.5	168.22	0.25	29.9	0.130	33.1	8.40	11.63	11.00	0.22	-
Maximum	60.0	27.3	226.00	3.10	65.0	0.760	61.5	19.20	25.00	24.50	0.99	-
n	272	271	221	212	272	224	272	189	192	250	84	-
Standard Deviation	8.1	2.7	32.57	0.32	14.2	0.064	9.6	2.33	3.67	3.32	0.18	-
Standard Error	0.5	0.2	2.19	0.02	0.9	0.004	0.6	0.17	0.26	0.21	0.02	-
Begin Year	1977	1977	1984	1984	1977	1977	1977	1977	1977	1977	1984	-
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	1996	-
Censored Values	-	-	-	204	-	3	-	-	-	-	-	-

Table 2 Summary statistics for routine water quality variables in the Athabasca River at the Hinton and Athabasca sampling stations for the period **1957-2007** (continued).

	Dissolved Kjeldahl Nitrogen (mg/L)	Total Ammonia Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrite + Nitrate Nitrogen (mg/L)	Total Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Nitrite Nitrogen (mg/L)	Total Phosphorus (mg/L)	Total Dissolved Phophorus (mg/L)	Chlorophyll *a* (mg/L)	Total Coliform Bacteria (cells/100mL)	Fecal Coliform Bacteria (cells/100mL)	*Escherichia coli* (cells/100mL)
Hinton													
Minimum	-	0.005	0.025	0.014	0.063	0.014	0.0015	0.0015	0.001	0.0001	-	2.00	5.00
First Quartile	-	0.005	0.050	0.058	0.136	0.058	0.0015	0.0070	0.002	0.0002	-	5.00	5.00
Mean	-	0.019	0.104	0.083	0.187	0.083	0.0021	0.0215	0.003	0.0003	-	7.94	7.30
Median	-	0.010	0.090	0.077	0.174	0.077	0.0015	0.0120	0.002	0.0003	-	5.00	5.00
Third Quartile	-	0.025	0.130	0.106	0.218	0.102	0.0015	0.0230	0.003	0.0004	-	5.00	5.00
Maximum	-	0.120	0.370	0.263	0.472	0.263	0.0260	0.3010	0.025	0.0013	-	80.00	80.00
n	-	102	102	102	102	100	100	101	102	100	-	101	100
Standard Deviation	-	0.019	0.079	0.036	0.083	0.036	0.0027	0.0367	0.004	0.0002	-	10.02	9.41
Standard Error	-	0.002	0.008	0.004	0.008	0.004	0.0003	0.0036	0.000	0.0000	-	1.00	0.94
Begin Year	-	1999	1999	1999	1999	1999	1999	1999	1999	1999	-	1999	1999
End Year	-	2007	2007	2007	2007	2007	2007	2007	2007	2007	-	2007	2007
Censored Values	-	39	24	-	-	-	89	4	63	-	-	82	89
Athabasca													
Minimum	0.01	0.01	0.01	0.00	0.03	0.000	0.002	0.004	0.002	0.0002	0.5	0.5	2.0
First Quartile	0.21	0.01	0.26	0.01	0.29	0.005	0.002	0.014	0.004	0.0006	11.0	2.0	5.0
Mean	0.29	0.04	0.41	0.07	0.46	0.091	0.003	0.066	0.011	0.0027	164.2	16.1	10.1
Median	0.26	0.03	0.35	0.04	0.40	0.068	0.002	0.025	0.007	0.0020	36.0	5.0	5.0
Third Quartile	0.36	0.05	0.46	0.10	0.55	0.136	0.003	0.070	0.012	0.0037	94.0	10.0	5.0
Maximum	0.80	0.37	1.90	0.43	2.67	0.678	0.018	0.682	0.270	0.0210	3600.0	360.0	100.0
n	104	342	259	454	362	157	109	364	342	329	224	341	101
Standard Deviation	0.12	0.04	0.26	0.07	0.29	0.100	0.003	0.098	0.019	0.0029	449.8	36.4	15.4
Standard Error	0.01	0.00	0.02	0.00	0.02	0.008	0.000	0.005	0.001	0.0002	30.1	2.0	1.5
Begin Year	1987	1977	1969	1965	1969	1960	1987	1973	1978	1973	1977	1977	1998
End Year	1996	2007	2007	2007	2007	2007	2007	2007	2007	2007	1999	2007	2007
Censored Values	-	181	-	53	-	28	76	-	39	-	-	132	76

Table 2 Summary statistics for routine water quality variables in the Athabasca River at the Fort McMurray and Old Fort sampling stations for the period **1957-2007** (continued).

	Dissolved Kjeldahl Nitrogen (mg/L)	Total Ammonia Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrite + Nitrate Nitrogen (mg/L)	Total Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Nitrite Nitrogen (mg/L)	Total Phosphorus (mg/L)	Total Dissolved Phophorus (mg/L)	Chlorophyll *a* (mg/L)	Total Coliform Bacteria (cells/100mL)	Fecal Coliform Bacteria (cells/100mL)	*Escherichia coli* (cells/100mL)
Fort McMurray													
Minimum	-	0.005	0.150	0.002	0.152	0.002	0.0015	0.0050	0.002	0.0002	-	5.00	5.00
First Quartile	-	0.010	0.330	0.002	0.365	0.002	0.0015	0.0193	0.006	0.0007	-	5.00	5.00
Mean	-	0.041	0.459	0.090	0.548	0.090	0.0022	0.0686	0.022	0.0038	-	20.69	17.50
Median	-	0.030	0.390	0.021	0.525	0.016	0.0015	0.0345	0.009	0.0031	-	10.00	5.00
Third Quartile	-	0.060	0.533	0.142	0.671	0.142	0.0015	0.0875	0.018	0.0054	-	10.00	10.00
Maximum	-	0.140	1.180	0.843	1.233	0.835	0.0120	0.4200	0.267	0.0167	-	220.00	190.00
n	-	64	64	64	64	63	63	62	63	61	-	61	60
Standard Deviation	-	0.036	0.214	0.136	0.239	0.135	0.0019	0.0858	0.043	0.0035	-	38.91	36.40
Standard Error	-	0.005	0.027	0.017	0.030	0.017	0.0002	0.0109	0.005	0.0005	-	4.98	4.70
Begin Year	-	2002	2002	2002	2002	2002	2002	2002	2002	2002	-	2002	2002
End Year	-	2007	2007	2007	2007	2007	2007	2007	2007	2007	-	2007	2007
Censored Values	-	16	-	21	-	21	50	-	5	-	-	28	38
Old Fort													
Minimum	0.04	0.01	0.01	0.00	0.00	0.002	0.001	0.014	0.002	0.0000	2.0	0.5	2.0
First Quartile	0.28	0.01	0.38	0.01	0.42	0.006	0.002	0.032	0.008	0.0005	9.2	2.0	5.0
Mean	0.37	0.04	0.59	0.09	0.63	0.095	0.006	0.081	0.016	0.0043	75.9	10.3	7.7
Median	0.36	0.03	0.48	0.05	0.57	0.052	0.002	0.048	0.012	0.0035	33.0	5.0	5.0
Third Quartile	0.42	0.07	0.65	0.16	0.76	0.162	0.005	0.097	0.018	0.0071	73.0	10.0	10.0
Maximum	0.80	0.20	6.55	0.49	6.60	0.471	0.300	0.750	0.096	0.0244	1200.0	240.0	30.0
n	87	205	252	269	267	133	150	271	218	221	112	194	82
Standard Deviation	0.13	0.04	0.50	0.10	0.50	0.102	0.025	0.088	0.013	0.0040	144.2	23.1	5.7
Standard Error	0.01	0.00	0.03	0.01	0.03	0.009	0.002	0.005	0.001	0.0003	13.6	1.7	0.6
Begin Year	1987	1987	1977	1977	1977	1977	1977	1977	1984	1978	1978	1978	1996
End Year	1996	2007	2007	2007	2007	2007	2007	2007	2007	2007	2002	2007	2007
Censored Values	-	52	-	48	-	26	72	-	5	-	5	106	55

Table 3 Summary statistics for routine water quality variables in the Athabasca River at the Athabasca and Old Fort sampling stations for the period **1987-2007.**

	Flow (m^3/s)	Temperature (°C)	pH	Conductivity (µS/cm)	Alkalinity (mg $CaCO_3$/L)	Hardness (mg $CaCO_3$/L)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Non-Filterable Residue (mg/L)	Total Dissolved Solids (mg/L)	Filterable Residue (mg/L)	Dissolved Potassium (mg/L)	Dissolved Sodium (mg/L)
Upstream (Athabasca)													
Minimum	42.00	-0.40	6.18	186.0	78.2	86.00	7.30	0.4	0.2	107.0	94.9	0.4	2.7
First Quartile	102.75	0.00	7.64	231.3	102.5	110.00	8.86	3.0	1.2	132.8	147.0	0.9	6.0
Mean	411.98	7.38	7.92	319.5	135.1	148.90	10.32	40.1	67.4	187.1	197.7	1.5	11.1
Median	249.00	4.93	7.93	292.5	126.0	140.00	9.87	7.6	8.0	170.5	187.0	1.3	9.8
Third Quartile	572.00	14.97	8.17	404.8	168.0	184.30	11.60	47.5	61.8	241.3	243.5	1.7	15.2
Maximum	2730.00	20.99	10.10	528.0	222.0	243.90	15.80	440.0	1680.0	310.0	388.0	18.0	31.5
n	251	239	245	238	239	241	242	238	238	140	231	239	239
Standard Deviation	409.34	7.69	0.42	92.7	35.8	41.21	1.73	69.8	157.8	60.1	60.5	1.3	5.9
Standard Error	25.89	0.50	0.03	6.0	2.3	2.65	0.11	4.5	10.2	5.1	4.0	0.1	0.4
Begin Year	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	-	-	-	-	-	-	-	-	21	-	-	-	-
Downstream (Old Fort)													
Minimum	91.00	-0.30	6.41	168.0	65.1	66.60	7.18	2.6	0.2	103.0	70.0	0.2	4.6
First Quartile	173.75	0.00	7.51	238.0	94.0	100.00	8.86	6.0	5.0	129.5	151.0	1.0	10.7
Mean	550.28	7.00	7.70	337.3	117.2	126.42	10.12	48.9	66.2	185.0	200.9	1.4	21.5
Median	390.00	1.00	7.72	313.5	114.0	124.11	10.08	14.6	22.0	169.0	190.0	1.3	19.6
Third Quartile	821.25	14.10	7.90	421.0	139.0	150.00	11.18	58.1	81.0	232.5	252.0	1.6	31.0
Maximum	2190.00	23.50	8.70	598.0	185.0	200.00	14.29	1290.0	505.0	342.0	328.0	8.2	51.4
n	248	175	219	196	216	215	190	214	216	131	205	216	216
Standard Deviation	477.85	7.98	0.35	106.4	26.7	29.52	1.62	103.0	101.3	61.7	61.0	0.7	12.0
Standard Error	30.34	0.60	0.02	7.6	1.8	2.01	0.12	7.0	6.9	5.4	4.3	0.0	0.8
Begin Year	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	-	-	-	-	-	-	-	-	4	-	-	1	-

Table 3 Summary statistics for routine water quality variables in the Athabasca River at the Athabasca and Old Fort sampling stations for the period **1987-2007** (continued).

	Dissolved Calcium (mg/L)	Dissolved Magnesium (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulphate (mg/L)	Silica (mg/L)	Total Organic Carbon (mg/L)	Particulate Organic Carbon (mg/L)	Dissolved Organic Carbon (mg/L)	Particulate Nitrogen (mg/L)	Dissolved Kjeldahl Nitrogen (mg/L)
Upstream (Athabasca)													
Minimum	22.5	5.6	95.30	0.25	0.3	0.025	11.1	0.25	1.40	-	1.30	0.01	0.01
First Quartile	31.4	8.2	124.67	0.25	1.4	0.083	21.0	3.42	5.30	-	5.00	0.04	0.21
Mean	41.3	11.1	164.58	0.32	2.9	0.117	33.6	4.51	7.13	-	6.57	0.17	0.29
Median	38.5	10.4	153.00	0.25	2.5	0.110	29.5	4.59	6.60	-	6.10	0.08	0.26
Third Quartile	51.2	13.7	205.00	0.25	4.1	0.130	45.8	5.59	8.40	-	7.80	0.22	0.36
Maximum	68.0	18.3	271.00	4.60	11.3	1.120	71.1	7.42	19.00	-	25.10	0.96	0.80
n	239	239	239	235	238	242	239	170	167	-	237	96	104
Standard Deviation	11.3	3.3	43.61	0.40	1.8	0.081	14.8	1.33	2.89	-	2.86	0.22	0.12
Standard Error	0.7	0.2	2.82	0.03	0.1	0.004	1.0	0.10	0.22	-	0.19	0.02	0.01
Begin Year	1987	1987	1987	1987	1987	1987	1987	1987	1987	-	1987	1987	1987
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	-	2007	1996	2007
Censored Values	-	-	-	227	1	3	-	-	-	-	-	-	-
Downstream (Old Fort)													
Minimum	19.1	4.6	79.30	0.25	1.2	0.025	8.5	2.65	3.50	-	2.90	0.01	0.04
First Quartile	27.9	7.4	114.00	0.25	8.0	0.100	18.5	4.80	7.05	-	6.80	0.03	0.28
Mean	35.0	9.5	142.65	0.29	20.4	0.126	26.4	6.55	9.59	-	9.01	0.15	0.37
Median	34.5	9.7	138.97	0.25	17.2	0.120	25.4	5.85	8.70	-	8.10	0.08	0.36
Third Quartile	41.2	11.4	168.61	0.25	30.6	0.130	34.0	8.58	11.65	-	11.00	0.22	0.42
Maximum	54.8	15.7	226.00	3.10	64.2	0.760	53.9	19.20	20.00	-	19.70	0.99	0.80
n	216	216	215	208	216	204	216	151	143	-	213	81	87
Standard Deviation	8.0	2.4	32.60	0.32	14.3	0.064	9.5	2.45	3.50	-	3.20	0.18	0.13
Standard Error	0.5	0.2	2.22	0.02	1.0	0.004	0.6	0.20	0.29	-	0.22	0.02	0.01
Begin Year	1987	1987	1987	1987	1987	1987	1987	1987	1987	-	1987	1988	1987
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	-	2007	1996	2007
Censored Values	-	-	-	204	-	2	-	-	-	-	-	-	-

Table 3 Summary statistics for routine water quality variables in the Athabasca River at the Athabasca and Old Fort sampling stations for the period **1987-2007** (continued).

	Total Ammonia Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrite + Nitrate Nitrogen (mg/L)	Total Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Nitrite Nitrogen (mg/L)	Total Phosphorus (mg/L)	Total Dissolved Phophorus (mg/L)	Chlorophyll *a* (mg/L)	Total Coliform Bacteria (cells/100mL)	Fecal Coliform Bacteria (cells/100mL)	*Escherichia coli* (cells/100mL)
Upstream (Athabasca)												
Minimum	0.01	0.01	0.00	0.03	0.002	0.002	0.005	0.002	0.0002	2.0	0.5	2.0
First Quartile	0.01	0.25	0.00	0.30	0.002	0.002	0.014	0.005	0.0006	20.0	4.0	5.0
Mean	0.03	0.41	0.07	0.47	0.067	0.003	0.064	0.013	0.0024	150.1	18.0	10.1
Median	0.02	0.34	0.04	0.42	0.037	0.002	0.025	0.008	0.0020	48.0	5.0	5.0
Third Quartile	0.04	0.44	0.11	0.55	0.123	0.003	0.064	0.014	0.0036	109.0	10.3	5.0
Maximum	0.37	1.90	0.38	1.95	0.264	0.018	0.682	0.270	0.0088	2400.0	360.0	100.0
n	235	238	238	238	101	109	239	239	240	135	240	101
Standard Deviation	0.04	0.26	0.07	0.29	0.079	0.003	0.096	0.022	0.0019	355.8	40.6	15.4
Standard Error	0.00	0.02	0.00	0.02	0.008	0.000	0.006	0.001	0.0001	30.6	2.6	1.5
Begin Year	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987	1987	1998
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	1999	2007	2007
Censored Values	82	-	53	-	28	76	-	31	-	-	120	76
Downstream (Old Fort)												
Minimum	0.01	0.01	0.00	0.03	0.002	0.001	0.014	0.002	0.0000	2.0	0.5	2.0
First Quartile	0.01	0.36	0.01	0.43	0.004	0.002	0.032	0.008	0.0005	9.0	2.0	5.0
Mean	0.04	0.54	0.08	0.62	0.088	0.006	0.076	0.016	0.0043	51.1	7.7	7.7
Median	0.03	0.46	0.05	0.57	0.051	0.002	0.048	0.012	0.0035	32.0	5.0	5.0
Third Quartile	0.07	0.61	0.15	0.70	0.170	0.003	0.094	0.018	0.0071	64.0	10.0	10.0
Maximum	0.20	6.55	0.49	6.60	0.346	0.300	0.370	0.096	0.0244	400.0	140.0	30.0
n	205	213	214	213	91	102	216	213	214	100	182	82
Standard Deviation	0.04	0.48	0.09	0.48	0.096	0.030	0.073	0.013	0.0041	69.2	11.9	5.7
Standard Error	0.00	0.03	0.01	0.03	0.010	0.003	0.005	0.001	0.0003	6.9	0.9	0.6
Begin Year	1987	1987	1987	1987	1999	1987	1987	1987	1987	1987	1987	1996
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2002	2007	2007
Censored Values	52	-	46	-	20	61	-	5	-	5	105	55

Table 4 Summary statistics for metals data in the Athabasca River at the Hinton and Athabasca sampling stations for the period **1994-2007**.

	Total Silver (µg/L)	Dissolved Silver (µg/L)	Total Aluminum (mg/L)	Dissolved Aluminum (mg/L)	Total Arsenic (µg/L)	Dissolved Arsenic (µg/L)	Total Barium (mg/L)	Dissolved Barium (mg/L)	Total Boron (mg/L)	Dissolved Boron (mg/L)	Total Beryllium (µg/L)	Dissolved Beryllium (µg/L)
Hinton												
Minimum	0.00025	0.00025	0.00730	0.00050	0.06710	0.04000	0.03490	0.02110	0.00500	0.00289	0.00150	0.00150
First Quartile	0.00210	0.00025	0.11400	0.00350	0.10000	0.07500	0.04130	0.03755	0.00500	0.00500	0.01460	0.00150
Mean	0.08652	0.00704	0.42612	0.01151	0.21134	0.10548	0.05262	0.04416	0.01080	0.00649	0.03201	0.00320
Median	0.00290	0.00053	0.29300	0.00700	0.16500	0.10000	0.05190	0.04440	0.00746	0.00500	0.02240	0.00150
Third Quartile	0.00978	0.00238	0.42800	0.01130	0.21200	0.10300	0.05920	0.05195	0.01000	0.00727	0.03500	0.00263
Maximum	1.60000	0.05000	3.69000	0.04800	0.70000	0.20000	0.12100	0.06560	0.07000	0.02000	0.16400	0.02000
n	20	18	34	32	34	32	34	32	34	32	15	14
Standard Deviation	0.35641	0.01595	0.64550	0.01276	0.16279	0.04569	0.01573	0.01061	0.01158	0.00310	0.03906	0.00489
Standard Error	0.07969	0.00376	0.11237	0.00229	0.02834	0.00821	0.00274	0.00190	0.00202	0.00056	0.01009	0.00131
Begin Year	2002	2002	1999	1999	1999	1999	1999	1999	1999	1999	2004	2004
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	0	0	0	0	0	0	0	0	0	0	0	0
Athabasca												
Minimum	0.00025	0.00025	0.00250	0.00050	0.10000	0.10000	0.00700	0.03960	0.00500	0.00500	0.00350	0.00150
First Quartile	0.00265	0.00025	0.03100	0.00294	0.40000	0.30000	0.06785	0.05503	0.01178	0.00940	0.01440	0.00150
Mean	0.03590	0.00669	0.93344	0.01739	0.91602	0.38659	0.09115	0.06538	0.02403	0.01434	0.09039	0.00380
Median	0.00885	0.00073	0.10400	0.00739	0.50500	0.40000	0.08380	0.06200	0.01855	0.01070	0.03220	0.00150
Third Quartile	0.04250	0.00273	0.77400	0.01540	0.90000	0.48250	0.09570	0.07243	0.03000	0.01515	0.13250	0.00330
Maximum	0.30000	0.05000	8.48000	0.23300	6.60000	0.90000	0.23500	0.10500	0.18000	0.07000	0.46000	0.02000
n	20	20	85	34	50	34	51	34	40	34	15	15
Standard Deviation	0.06638	0.01506	1.81141	0.03988	1.17205	0.18337	0.04157	0.01626	0.02779	0.01153	0.12605	0.00494
Standard Error	0.01484	0.00337	0.19648	0.00684	0.16575	0.03145	0.00582	0.00279	0.00439	0.00198	0.03255	0.00127
Begin Year	2002	2002	1994	1999	1995	1999	1994	1999	1997	1999	2004	2004
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	4	12	2	-	4	5	-	-	4	3	1	10

Table 4 Summary statistics for metals data in the Athabasca River at the Fort McMurray and Old Fort sampling stations for the period **1994-2007** (continued).

	Total Silver (µg/L)	Dissolved Silver (µg/L)	Total Aluminum (mg/L)	Dissolved Aluminum (mg/L)	Total Arsenic (µg/L)	Dissolved Arsenic (µg/L)	Total Barium (mg/L)	Dissolved Barium (mg/L)	Total Boron (mg/L)	Dissolved Boron (mg/L)	Total Beryllium (µg/L)	Dissolved Beryllium (µg/L)
Fort McMurray												
Minimum	0.00025	0.00025	0.02060	0.00364	0.28700	0.10000	0.05010	0.04250	0.01000	0.00500	0.00150	0.00150
First Quartile	0.00186	0.00025	0.09725	0.00623	0.51125	0.38300	0.06905	0.04740	0.02305	0.02025	0.01290	0.00150
Mean	0.02108	0.00704	2.20059	0.02119	1.04582	0.44626	0.09542	0.05872	0.02830	0.02508	0.11850	0.00728
Median	0.00640	0.00025	0.94000	0.00976	0.67850	0.48300	0.07820	0.05420	0.02840	0.02530	0.04830	0.00400
Third Quartile	0.02625	0.00250	2.56500	0.02360	1.19250	0.52500	0.08948	0.05960	0.03000	0.02880	0.09550	0.00998
Maximum	0.10400	0.05000	11.60000	0.08800	3.88000	0.70000	0.31200	0.10300	0.04790	0.04370	0.74000	0.02380
n	20	17	22	19	22	19	22	19	22	19	15	12
Standard Deviation	0.03025	0.01623	3.30372	0.02432	0.91596	0.15848	0.06219	0.01624	0.00896	0.00986	0.20638	0.00761
Standard Error	0.00676	0.00394	0.70436	0.00558	0.19528	0.03636	0.01326	0.00373	0.00191	0.00226	0.05329	0.00220
Begin Year	2002	2002	2002	2002	2002	2002	2002	2002	2002	2002	2004	2004
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	0	0	0	0	0	0	0	0	0	0	0	0
Old Fort												
Minimum	0.00025	0.00025	0.00250	0.00200	0.10000	0.10000	0.03600	0.03310	0.00500	0.00500	0.00150	0.00150
First Quartile	0.00410	0.00025	0.05775	0.00599	0.50000	0.40000	0.05825	0.04095	0.02220	0.02000	0.02000	0.00150
Mean	0.05230	0.00576	0.98956	0.01438	1.14496	0.47165	0.08055	0.05505	0.05384	0.02512	0.08743	0.00626
Median	0.01200	0.00090	0.24200	0.00950	0.75000	0.47300	0.06770	0.04605	0.03000	0.02140	0.03335	0.00400
Third Quartile	0.04100	0.00250	1.32050	0.02033	1.39000	0.56825	0.08220	0.05223	0.04000	0.03000	0.12600	0.00888
Maximum	0.70000	0.05000	8.22000	0.06270	5.00000	1.10000	0.26900	0.26800	0.84800	0.06000	0.27700	0.02000
n	21	21	80	34	50	34	51	34	42	34	16	16
Standard Deviation	0.14996	0.01475	1.64145	0.01325	1.06053	0.18583	0.04106	0.03931	0.12797	0.01086	0.09780	0.00586
Standard Error	0.03272	0.00322	0.18352	0.00227	0.14998	0.03187	0.00575	0.00674	0.01975	0.00186	0.02445	0.00147
Begin Year	2002	2002	1995	1999	1995	1999	1994	1999	1997	1999	2004	2004
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	3	14	-	-	3	3	-	-	3	2	3	5

Table 4 **Summary statistics for metals data in the Athabasca River at the Hinton and Athabasca sampling stations for the period 1994-2007** (continued).

	Total Cadmium (µg/L)	Dissolved Cadmium (µg/L)	Total Cobalt (µg/L)	Dissolved Cobalt (µg/L)	Total Chromium (mg/L)	Dissolved Chromium (µg/L)	Hexavalent Chromium (mg/L)	Total Copper (µg/L)	Dissolved Copper (µg/L)	Total Iron (mg/L)	Dissolved Iron (mg/L)	Total Lithium (mg/L)	Dissolved Lithium (mg/L)
Hinton													
Minimum	0.00270	0.00100	0.00050	0.00050	0.00002	0.01500	0.00050	0.20000	0.10000	0.00100	0.00100	0.00122	0.00050
First Quartile	0.00710	0.00260	0.15000	0.01100	0.00050	0.04500	0.00050	0.60000	0.29550	0.24000	0.00500	0.00200	0.00180
Mean	0.03111	0.01238	0.34103	0.03519	0.00151	0.15765	0.00068	1.45685	0.62897	0.51674	0.01922	0.00319	0.00231
Median	0.01000	0.00500	0.21700	0.02020	0.00060	0.16500	0.00050	0.94000	0.40900	0.39300	0.00500	0.00303	0.00200
Third Quartile	0.01325	0.01000	0.40000	0.04640	0.00155	0.20000	0.00050	1.50000	0.69400	0.73200	0.02000	0.00400	0.00312
Maximum	0.40000	0.10000	1.70000	0.15000	0.00800	0.50000	0.00200	10.90000	3.10000	2.61000	0.37000	0.00600	0.00400
n	19	17	34	17	34	17	19	34	32	34	89	34	32
Standard Deviation	0.08953	0.02339	0.34172	0.03661	0.00188	0.12899	0.00048	1.95717	0.61512	0.47254	0.05036	0.00118	0.00101
Standard Error	0.02054	0.00567	0.05949	0.00888	0.00033	0.03128	0.00011	0.34070	0.11048	0.08226	0.00537	0.00020	0.00018
Begin Year	2003	2003	1999	2003	1999	2003	2004	1999	1999	1999	1999	1999	1999
End Year	2007	2007	2007	2007	2007	2007	2008	2007	2007	2007	2007	2007	2007
Censored Values	0	0	0	0	0	0	16	0	0	0	0	0	0
Athabasca													
Minimum	0.02000	0.00500	0.03690	0.01400	0.00022	0.01500	0.00050	0.10000	0.10000	0.00500	0.00150	0.00200	0.00100
First Quartile	0.03000	0.01135	0.15200	0.03510	0.00050	0.14250	0.00050	1.08000	0.69550	0.18525	0.03000	0.00500	0.00260
Mean	0.05800	0.02505	1.18289	0.07207	0.00346	0.25705	0.00081	3.50340	1.04221	1.69123	0.07702	0.00588	0.00436
Median	0.04000	0.01880	0.50000	0.06000	0.00200	0.24000	0.00050	2.00000	0.90000	0.45500	0.06000	0.00570	0.00400
Third Quartile	0.07000	0.02815	1.52500	0.09750	0.00555	0.40200	0.00100	4.73000	1.48000	1.53750	0.09000	0.00684	0.00500
Maximum	0.18200	0.10000	7.49000	0.15000	0.01830	0.50000	0.00200	16.40000	2.40000	16.60000	1.59000	0.01290	0.01000
n	19	19	46	19	83	19	18	85	34	80	261	34	34
Standard Deviation	0.04343	0.02288	1.61001	0.04165	0.00383	0.16038	0.00049	3.66179	0.55367	3.27226	0.11838	0.00232	0.00218
Standard Error	0.00996	0.00525	0.23738	0.00956	0.00042	0.03679	0.00012	0.39718	0.09495	0.36585	0.00733	0.00040	0.00037
Begin Year	2003	2003	1996	2003	1994	2003	2004	1994	1999	1994	1980	1999	1999
End Year	2007	2007	2007	2007	2007	2007	2008	2007	2007	2007	2007	2007	2007
Censored Values	1	2	7	1	21	3	11	-	2	-	19	3	7

Table 4 Summary statistics for metals data in the Athabasca River at the Fort McMurray and Old Fort sampling stations for the period **1994-2007**.

	Total Cadmium (µg/L)	Dissolved Cadmium (µg/L)	Total Cobalt (µg/L)	Dissolved Cobalt (µg/L)	Total Chromium (mg/L)	Dissolved Chromium (µg/L)	Hexavalent Chromium (mg/L)	Total Copper (µg/L)	Dissolved Copper (µg/L)	Total Iron (mg/L)	Dissolved Iron (mg/L)	Total Lithium (mg/L)	Dissolved Lithium (mg/L)
Fort McMurray													
Minimum	0.01400	0.00670	0.02900	0.01600	0.00017	0.11000	0.00050	0.10000	0.10000	0.07600	0.00500	0.00200	0.00200
First Quartile	0.02765	0.01353	0.14625	0.07260	0.00043	0.24075	0.00050	0.77025	0.67750	0.21950	0.05820	0.00637	0.00485
Mean	0.06329	0.02733	1.25423	0.10501	0.00397	0.30431	0.00119	3.37623	1.21647	2.37759	0.10284	0.00819	0.00602
Median	0.03400	0.01750	0.48250	0.10450	0.00285	0.31500	0.00100	1.53000	0.91000	1.15500	0.08000	0.00795	0.00639
Third Quartile	0.05500	0.03030	0.95900	0.13500	0.00394	0.38225	0.00100	3.06250	1.39000	2.12500	0.13500	0.00942	0.00772
Maximum	0.27300	0.10000	12.10000	0.23100	0.02910	0.50000	0.00800	27.80000	3.38000	15.80000	0.48000	0.02120	0.01030
n	19	16	22	16	22	16	27	22	19	22	47	22	19
Standard Deviation	0.06996	0.02526	2.64051	0.05414	0.00631	0.11266	0.00146	5.91011	0.80918	3.87851	0.08000	0.00404	0.00239
Standard Error	0.01605	0.00632	0.56296	0.01353	0.00134	0.02816	0.00028	1.26004	0.18564	0.82690	0.01167	0.00086	0.00055
Begin Year	2003	2003	2002	2003	2002	2003	2004	2002	2002	2002	2002	2002	2002
End Year	2007	2007	2007	2007	2007	2007	2008	2007	2007	2007	2007	2007	2007
Censored Values	0	0	0	0	0	0	12	0	0	0	0	0	0
Old Fort													
Minimum	0.00940	0.00500	0.02170	0.02150	0.00041	0.02000	0.00050	0.10000	0.10000	0.00500	0.00500	0.00200	0.00200
First Quartile	0.02943	0.01860	0.21100	0.05750	0.00100	0.31475	0.00050	1.68500	0.86900	0.52000	0.10750	0.00680	0.00464
Mean	0.10764	0.04827	1.01308	0.07578	0.00394	0.39130	0.00200	3.53157	1.58230	2.13793	0.16739	0.00954	0.00600
Median	0.08450	0.02665	0.70000	0.07490	0.00200	0.39000	0.00100	2.95000	1.39000	0.89000	0.16000	0.00770	0.00587
Third Quartile	0.14250	0.04958	1.30000	0.09268	0.00550	0.51750	0.00200	5.02250	1.87000	3.01500	0.21000	0.00900	0.00728
Maximum	0.44000	0.26300	5.70000	0.15000	0.01600	0.66000	0.01000	12.20000	5.80000	11.80000	1.16000	0.05400	0.01100
n	20	20	47	20	79	20	19	82	33	79	156	35	34
Standard Deviation	0.10815	0.06021	1.06853	0.03026	0.00391	0.18628	0.00239	2.69402	1.14098	2.52409	0.12934	0.00918	0.00206
Standard Error	0.02418	0.01346	0.15586	0.00677	0.00044	0.04165	0.00055	0.29750	0.19862	0.28398	0.01036	0.00155	0.00035
Begin Year	2003	2003	1996	2003	1994	2003	2004	1994	1999	1994	1987	1999	1999
End Year	2007	2007	2007	2007	2007	2007	2008	2007	2007	2007	2007	2007	2007
Censored Values	1	2	7	1	13	3	6	-	1	-	6	1	2

Table 4 Summary statistics for metals data in the Athabasca River at the Hinton and Athabasca sampling stations for the period **1999-2007**.

	Total Manganese (mg/L)	Dissolved Manganese (mg/L)	Total Molybdenum (mg/L)	Dissolved Molybdenum (µg/L)	Total Nickel (µg/L)	Dissolved Nickel (µg/L)	Total Lead (µg/L)	Dissolved Lead (µg/L)	Total Selenium (µg/L)	Dissolved Selenium (µg/L)	Total Antimony (µg/L)	Dissolved Antimony (µg/L)
Hinton												
Minimum	0.00009	0.00008	0.00015	0.11700	0.00250	0.00250	0.00640	0.00050	0.05000	0.05000	0.01200	0.01600
First Quartile	0.00900	0.00200	0.00050	0.42400	0.25000	0.00250	0.20700	0.00710	0.20050	0.12200	0.02140	0.02050
Mean	0.01551	0.00509	0.00077	0.71207	1.63462	1.03604	1.12940	0.02267	0.26158	0.22600	0.03506	0.03721
Median	0.01300	0.00200	0.00079	0.72200	0.80000	0.20100	0.40000	0.01620	0.25300	0.25000	0.02440	0.02310
Third Quartile	0.02200	0.00500	0.00100	1.00000	2.10000	1.50000	0.60000	0.02120	0.31500	0.31000	0.02900	0.03270
Maximum	0.04900	0.03100	0.00143	1.20000	9.10000	6.60000	20.70000	0.15000	0.45100	0.43500	0.14900	0.14800
n	34	72	34	29	34	29	34	17	19	17	19	17
Standard Deviation	0.00986	0.00690	0.00030	0.30586	2.14423	1.79340	3.53913	0.03427	0.09874	0.12000	0.03307	0.03481
Standard Error	0.00172	0.00082	0.00005	0.05680	0.37326	0.33303	0.61608	0.00831	0.02265	0.02911	0.00759	0.00844
Begin Year	1999	1999	1999	1999	1999	2000	1999	2003	2003	2003	2003	2003
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	0	0	0	0	0	0	0	0	0	0	0	0
Athabasca												
Minimum	0.00050	0.00040	0.00010	0.10000	0.05800	0.00250	0.04640	0.00050	0.05000	0.05000	0.05000	0.04000
First Quartile	0.00728	0.00200	0.00058	0.51950	1.10000	0.32000	0.30000	0.03815	0.18500	0.12650	0.06175	0.05715
Mean	0.05394	0.00466	0.00106	0.70997	5.18035	1.40550	1.72852	0.06161	0.37947	0.24695	0.08992	0.07977
Median	0.01885	0.00200	0.00086	0.75500	3.70000	1.00000	0.70000	0.05360	0.25400	0.24400	0.07730	0.06710
Third Quartile	0.06000	0.00500	0.00110	0.90000	6.50000	1.95000	1.50000	0.08185	0.47500	0.26450	0.10900	0.09630
Maximum	0.41700	0.05400	0.00770	1.30000	22.60000	5.20000	14.90000	0.15000	1.31000	0.77000	0.19400	0.19200
n	80	163	49	31	49	31	61	19	19	19	19	19
Standard Deviation	0.08726	0.00681	0.00115	0.26985	5.56730	1.47715	2.75537	0.03948	0.30222	0.19582	0.04005	0.03617
Standard Error	0.00976	0.00053	0.00016	0.04847	0.79533	0.26530	0.35279	0.00906	0.06933	0.04492	0.00919	0.00830
Begin Year	1995	1987	1995	2000	1995	2000	1997	2003	2003	2003	2003	2003
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	1	13	1	-	1	1	7	2	1	7	1	1

Table 4 Summary statistics for metals data in the Athabasca River at the Fort McMurray and Old Fort sampling stations for the period **1999-2007** (continued).

	Total Manganese (mg/L)	Dissolved Manganese (mg/L)	Total Molybdenum (mg/L)	Dissolved Molybdenum (µg/L)	Total Nickel (µg/L)	Dissolved Nickel (µg/L)	Total Lead (µg/L)	Dissolved Lead (µg/L)	Total Selenium (µg/L)	Dissolved Selenium (µg/L)	Total Antimony (µg/L)	Dissolved Antimony (µg/L)
Fort McMurray												
Minimum	0.00273	0.00041	0.00028	0.27700	0.15500	0.14100	0.05870	0.02470	0.06100	0.02000	0.05000	0.04000
First Quartile	0.01120	0.00200	0.00054	0.50500	0.57500	0.50500	0.15000	0.04148	0.19550	0.17000	0.06390	0.06425
Mean	0.07162	0.00410	0.00072	0.64758	3.89255	1.17958	1.59594	0.09081	0.40200	0.26663	0.09277	0.08328
Median	0.04875	0.00200	0.00070	0.69000	1.69500	1.06000	0.68150	0.09120	0.28000	0.25000	0.08370	0.08200
Third Quartile	0.05875	0.00400	0.00087	0.75650	3.21500	1.60500	1.36000	0.12825	0.40000	0.30750	0.10700	0.09525
Maximum	0.59800	0.04700	0.00160	0.93200	32.40000	2.74000	11.00000	0.18000	1.76000	0.67000	0.18800	0.16000
n	22	35	22	19	22	19	22	16	19	16	19	14
Standard Deviation	0.13054	0.00768	0.00027	0.18250	7.02109	0.79371	2.76825	0.04946	0.39341	0.17374	0.03895	0.02912
Standard Error	0.02783	0.00130	0.00006	0.04187	1.49690	0.18209	0.59019	0.01236	0.09025	0.04344	0.00894	0.00778
Begin Year	2002	2002	2002	2002	2002	2002	2002	2003	2003	2003	2003	2003
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2006
Censored Values	0	0	0	0	0	0	0	0	0	0	0	0
Old Fort												
Minimum	0.00100	0.00050	0.00034	0.10000	0.00640	0.00630	0.09110	0.00050	0.05000	0.05000	0.05000	0.00700
First Quartile	0.03300	0.00200	0.00055	0.52700	1.15000	0.61400	0.57300	0.06168	0.21350	0.12800	0.07070	0.07065
Mean	0.06737	0.01668	0.00107	0.71803	4.64005	1.93210	2.31327	0.13713	0.32370	0.24345	0.15921	0.10047
Median	0.04385	0.00995	0.00080	0.60000	4.10000	1.13000	1.20000	0.12700	0.27650	0.18050	0.10100	0.09680
Third Quartile	0.08878	0.02400	0.00109	0.69000	6.17500	2.20000	2.07500	0.17050	0.45000	0.25000	0.15800	0.13250
Maximum	0.29500	0.17600	0.00540	2.60000	20.30000	9.70000	26.30000	0.47700	0.90000	1.20000	0.72500	0.20600
n	80	138	50	32	50	32	59	20	20	20	20	20
Standard Deviation	0.05578	0.02141	0.00096	0.44119	4.41406	2.25611	3.95427	0.10600	0.19071	0.24610	0.16222	0.05028
Standard Error	0.00624	0.00182	0.00014	0.07799	0.62424	0.39883	0.51480	0.02370	0.04264	0.05503	0.03627	0.01124
Begin Year	1995	1987	1995	2000	1995	2000	1997	2003	2003	2003	2003	2003
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	-	18	-	-	5	1	5	2	4	4	1	2

Table 4 Summary statistics for metals data in the Athabasca River at the Hinton and Athabasca sampling stations for the period **1999-2007** (continued).

	Total Strontium (mg/L)	Dissolved Strontium (mg/L)	Total Titanium (mg/L)	Dissolved Titanium (mg/L)	Total Thallium (µg/L)	Dissolved Thallium (µg/L)	Total Vanadium (µg/L)	Dissolved Vanadium (µg/L)	Total Zinc (mg/L)	Dissolved Zinc (mg/L)	Total Uranium (mg/L)	Dissolved Uranium (mg/L)
Hinton												
Minimum	0.06930	0.06860	0.00050	0.00010	0.00015	0.00015	0.08590	0.03300	0.00109	0.00030	0.00020	0.00020
First Quartile	0.28900	0.26000	0.00200	0.00049	0.00645	0.00130	0.50000	0.04590	0.00223	0.00156	0.00050	0.00034
Mean	0.46110	0.44025	0.00931	0.00073	0.02563	0.02061	0.89288	0.10209	0.00797	0.00387	0.00056	0.00050
Median	0.41800	0.40100	0.00400	0.00050	0.01300	0.00170	0.50000	0.07000	0.00630	0.00257	0.00055	0.00051
Third Quartile	0.66900	0.60300	0.00745	0.00063	0.03355	0.01700	1.29000	0.08520	0.01355	0.00579	0.00070	0.00063
Maximum	0.87500	0.84000	0.12600	0.00300	0.10000	0.10000	4.17000	0.50000	0.02190	0.01370	0.00100	0.00100
n	34	32	31	32	19	17	34	17	32	32	34	32
Standard Deviation	0.20700	0.20010	0.02222	0.00062	0.02984	0.03242	0.79065	0.11163	0.00617	0.00348	0.00020	0.00021
Standard Error	0.03603	0.03594	0.00399	0.00011	0.00685	0.00786	0.13763	0.02708	0.00111	0.00062	0.00004	0.00004
Begin Year	1999	1999	1999	1999	2003	2003	1999	2003	1999	1999	1999	1999
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	0	0	0	0	0	0	0	0	0	0	0	0
Athabasca												
Minimum	0.14200	0.11100	0.00050	0.00050	0.00300	0.00015	0.24800	0.16800	0.00050	0.00073	0.00020	0.00020
First Quartile	0.22150	0.19500	0.00200	0.00050	0.01010	0.00285	0.50000	0.19000	0.00513	0.00227	0.00043	0.00031
Mean	0.30514	0.28035	0.02470	0.00139	0.04086	0.01533	3.36015	0.30163	0.01381	0.00373	0.00054	0.00043
Median	0.28000	0.25400	0.00690	0.00071	0.01890	0.00480	1.00000	0.22400	0.00819	0.00331	0.00056	0.00041
Third Quartile	0.38350	0.34650	0.02795	0.00148	0.06850	0.01790	3.16500	0.33500	0.01670	0.00488	0.00066	0.00055
Maximum	0.58900	0.54900	0.15100	0.00653	0.12900	0.10000	32.00000	0.78000	0.06600	0.00910	0.00090	0.00090
n	35	34	31	34	19	19	47	19	79	32	42	34
Standard Deviation	0.12082	0.10991	0.03803	0.00158	0.04212	0.02598	5.67256	0.16117	0.01387	0.00215	0.00019	0.00017
Standard Error	0.02042	0.01885	0.00683	0.00027	0.00966	0.00596	0.82743	0.03697	0.00156	0.00038	0.00003	0.00003
Begin Year	1998	1999	2000	1999	2003	2003	1996	2003	1994	1999	1997	1999
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	-	-	1	11	1	3	15	1	2	-	6	7

Table 4 Summary statistics for metals data in the Athabasca River at the Fort McMurray and Old Fort sampling stations for the period **1999-2007** (continued).

	Total Strontium (mg/L)	Dissolved Strontium (mg/L)	Total Titanium (mg/L)	Dissolved Titanium (mg/L)	Total Thallium (µg/L)	Dissolved Thallium (µg/L)	Total Vanadium (µg/L)	Dissolved Vanadium (µg/L)	Total Zinc (mg/L)	Dissolved Zinc (mg/L)	Total Uranium (mg/L)	Dissolved Uranium (mg/L)
Fort McMurray												
Minimum	0.13600	0.13500	0.00100	0.00049	0.00420	0.00015	0.31900	0.13800	0.00123	0.00095	0.00037	0.00020
First Quartile	0.19275	0.18100	0.00258	0.00058	0.00980	0.00470	0.47000	0.21175	0.00410	0.00213	0.00046	0.00037
Mean	0.27159	0.25179	0.03998	0.00183	0.05781	0.02043	6.34223	0.34488	0.01439	0.00338	0.00061	0.00044
Median	0.25700	0.23700	0.01805	0.00100	0.03620	0.00700	2.77500	0.28900	0.00950	0.00261	0.00053	0.00043
Third Quartile	0.29100	0.28500	0.06120	0.00271	0.07450	0.02358	7.18500	0.45425	0.01580	0.00488	0.00065	0.00050
Maximum	0.49100	0.44200	0.19400	0.00935	0.22300	0.10000	50.10000	0.68500	0.08390	0.00835	0.00130	0.00080
n	22	19	22	19	19	16	22	16	21	18	22	19
Standard Deviation	0.09499	0.08708	0.05044	0.00210	0.06643	0.02739	11.11696	0.17444	0.01851	0.00211	0.00025	0.00013
Standard Error	0.02025	0.01998	0.01075	0.00048	0.01524	0.00685	2.37015	0.04361	0.00404	0.00050	0.00005	0.00003
Begin Year	2002	2002	2002	2002	2003	2003	2002	2003	2002	2002	2002	2002
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	0	0	0	0	0	0	0	0	0	0	0	0
Old Fort												
Minimum	0.11900	0.10500	0.00100	0.00050	0.00015	0.00015	0.50000	0.23000	0.00050	0.00081	0.00020	0.00020
First Quartile	0.17200	0.16500	0.00675	0.00081	0.02138	0.00548	0.71250	0.35800	0.00600	0.00229	0.00022	0.00020
Mean	0.22706	0.21524	0.02996	0.00229	0.07666	0.04183	3.95060	0.45770	0.01384	0.00511	0.00047	0.00029
Median	0.19700	0.19250	0.01595	0.00138	0.04245	0.01010	2.00000	0.44250	0.01070	0.00329	0.00040	0.00029
Third Quartile	0.25600	0.25200	0.03200	0.00300	0.11175	0.04035	5.50000	0.54475	0.02000	0.00672	0.00050	0.00037
Maximum	0.53800	0.43700	0.15000	0.01030	0.27000	0.27000	18.00000	0.69900	0.04560	0.01960	0.00300	0.00050
n	35	34	32	34	20	20	47	20	69	32	43	34
Standard Deviation	0.08893	0.07832	0.03634	0.00226	0.07784	0.06678	4.69154	0.14059	0.01008	0.00463	0.00044	0.00009
Standard Error	0.01503	0.01343	0.00642	0.00039	0.01741	0.01493	0.68433	0.03144	0.00121	0.00082	0.00007	0.00001
Begin Year	1999	1999	2000	1999	2003	2003	1996	2003	1994	1999	1997	1999
End Year	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Censored Values	-	-	-	8	2	2	12	1	1	-	11	10

Table 5 Water quality trends and guideline comparisons of long-term routine variables data collected from the Athabasca River at Athabasca, 1960-2008.

Variable	Overall Trend	Overall, Flow Adjusted	1987 Step	Pre-1987 Trend	Pre-1987, Flow Adjusted	Post-1987 Trend	Post-1987, Flow Adjusted	Comments	ASWQG[*]	% Compliance	CCMEWQG[**]	% Compliance
Flow (on sampling dates)	↔							No trends.				
Temperature	↓	↔	↓	↓	↓	↔	↔	Declining trend, prior to 1987.				
pH	↔	↔	↔	↔	↔	↔	↔	No trends.	6.5-8.5	98.0	6.5-9.0	99.3
Conductivity	↑	↑	↑	↔	↔	↔	↔	Increasing overall trend coincides with step.				
Total Alkalinity	↑	↑	↑	↔	↔	↔	↔	Increasing overall trend coincides with step.				
Hardness	↔	↔	↑	↓	↔	↔	↔	Decreasing trend, prior to 1987.				
DO	↔	↔	↑	↔	↔	↔	↔	Positive step in 1987.	6.5[a]	99.8		
Turbidity	↔	↑	↔	↑	↔	↓	↓	Declining trend, after 1987 (raw & flow adjusted).				
Non-Filterable Residue	↔	↔	↓	↑	↔	↔	↔	Increasing trend, prior to 1987				
Total Dissolved Solids						↔	↔	No trends.				
Filterable Residue						↑	↑	Increasing trend, after 1987 (raw & flow adjusted).				
Potassium	↔	↔	↔	↔	↔	↔	↔	No trends.				
Sodium	↑	↑	↑	↔	↑	↑	↑	Increasing trend, after 1987 (raw & flow adjusted).				
Calcium	↔	↔	↔	↔	↔	↔	↔	No trends.			1000[ls]	100
Magnesium	↑	↔	↑	↔	↓	↔	↔	Declining pre-87 trend, flow adjusted data.				
Bicarbonate						↔	↔	No trends.				
Carbonate								Insufficient data.				
Chloride	↓	↓	↓	↔	↔	↔	↓	Declining post-87 trend, flow adjusted data.			100-700[irr]	100
Fluoride	↑	↔	↑			↔	↔	Increasing trend coincides with step in data.			1.0	99.5
Sulphate	↑	↑	↑	↓	↓	↑	↑	Increasing trend, after 1987 (raw & flow adjusted).				
Silica	↓	↔	↓	↔	↔	↔	↔	Decreasing overall trend coincides with step.				
Total Organic Carbon	↔	↔	↓	↔	↔	↔	↔	Negative step in 1987.				
Dissolved Organic Carbon	↔	↔	↔	↔	↔	↔	↔	No trends.				

Table 5 Water quality trends and guideline comparisons of long-term routine variables data collected from the Athabasca River at Athabasca, 1960-2008 (continued).

Variable	Overall Trend	Overall, Flow Adjusted	1987 Step	Pre-1987 Trend	Pre-1987, Flow Adjusted	Post-1987 Trend	Post-1987, Flow Adjusted	Comments	ASWQG*	% Compliance	CCMEWQG**	% Compliance
Total Ammonia Nitrogen			↓			↑	↔	Increasing trend, after 1987.			0.019 mg/L[b]	99.7
Total Kjeldahl Nitrogen						↔	↓	Declining trend in flow adjusted data, after 1987.				
Nitrite and Nitrate Nitrogen	↔	↔	↔	↔	↑	↔	↔	Increasing trend in flow adjusted data, pre-1987.			100 mg/L[ls]	100
Total Nitrogen	↔	↔	↓	↔	↔	↔	↔	Negative step in 1987.	1.0 mg/L	94.8		
Total Phosphorus	↔	↑	↔	↔	↔	↔	↔	Increasing overall trend, flow adjusted data.	0.05	69.0		
Total Dissolved Phosphorus	↑	↔	↑	↔	↔	↔	↔	Increasing trend coincides with step in data.				
Chlorophyll a	↔	↔	↓			↔	↔	Negative step in 1987.				
Total Coliforms	↔	↔	↑	↔	↔	↔	↔	Positive step in 1987.			1000/100ml[irr]	96.4
Fecal Coliforms	↑	↑	↑	↔	↔	↔	↔	Increasing trend coincides with step in data.	100/100 mL[c]	98.2	100/100ml[irr]	98.2
Escherichia coli								Insufficient data.	400/100mL[c]	100		

*ASWQG = Alberta Surface Water Quality Guideline

**CCMEWQG = Canadian Council of Ministers of the Environment Guideline

Unless otherwise indicated, presented ASWQG and CCMEWQG values relate to the protection of aquatic life.

[a]Chronic exposure guideline based on life stages of aquatic biota.

[b]Based on un-ionized ammonia fraction, which is calculated as a function of pH and water temperature.

[c]Based on Alberta River Water Quality Index objectives.

[ls]As determined for livestock consumption.

[irr]As determined for irrigation water.

↓ - Decreasing trend, significant at a p-value of 0.05.

↑ - Increasing trend, significant at a p-value of 0.05.

↔ - No significant trend at a p-value of 0.05. This includes significant trends with a slope of zero.

Crossed out cells indicate that the analysis was not performed. Reasons are explained in the methods section.

Table 6 Water quality trends and guideline comparisons of long-term metals data collected from the Athabasca River at Athabasca, 1960-2008. Only those metals with sufficient data for trend analysis are depicted here.

Variable	Overall Trend (1977-2002)	Overall, Flow Adjusted	1987 Step Trend	Pre-1987 Trend	Pre-1987, Flow Adjusted	Post-1987 Trend	Post-1987, Flow Adjusted	Comments	ASWQG*	CCMEWQG** (mg/L)	% Compliance
Total Aluminum						↑	NS	Increasing trend, after 1987.		0.1[a]	49.4
Total Arsenic						NS	NS	No trend.		0.005	98.0
Total Barium						NS	NS	No trend.			
Total Copper						NS	NS	No trend.		Calculated	98.8
Total Iron						NS	NS	No trend.		0.3	42.5
Total Lead						NS	NS	No trend.		Calculated	86.9
Total Zinc						NS	NS	No trend.		0.03	87.3

*ASWQG = Alberta Surface Water Quality Guideline
**CCMEWQG = Canadian Council of Ministers of the Environment Guideline
Unless otherwise indicated, presented guideline values relate to the protection of aquatic life.

[a]Based on pH≥6.5 & $[Ca^{2+}]$>4 mg/L, DOC≥2 mg/L
↑ - Increasing trend, significant at a p-value of 0.05
↓ - Decreasing trend, significant at a p-value of 0.05
NS - Not Significant. Any trends not reporting significance at a p-value of 0.05.
Calculated = guideline is calculated individually for each sample, based on water hardness at time of sampling

Table 7 Water quality trends and guideline comparisons of long-term routine variables data collected from the Athabasca River at Old Fort, 1977-2008.

Variable	Overall Trend	Overall, Flow Adjusted	1987 Step	Pre-1987 Trend	Pre-1987, Flow Adjusted	Post-1987 Trend	Post-1987, Flow Adjusted	Comments	ASWQG*	% Compliance	CCMEWQG**	% Compliance
Flow (on sampling dates)	↓							Overall declining trend.				
Temperature	↔	↔	↔			↓	↔	Declining trend, after 1987.				
pH	↔	↔	↔	↔	↔	↑	↑	Increasing trend, post-1987 (raw & flow adjusted).	6.5-8.5	98.9	6.5-9.0	99.6
Conductivity	↔	↓	↑			↔	↓	Declining post-1987 trend, flow adjusted data.				
Total Alkalinity	↔	↔	↔			↔	↔	No trends.				
Hardness	↔	↓	↔			↔	↔	Declining overall trend, flow adjusted data.				
DO						↔	↔	No trends.	6.5[a]	99.5		
Turbidity						↑	↑	Increasing trend, post-1987 (raw & flow adjusted).				
Non-Filterable Residue	↔	↑	↓			↑	↑	Increasing trend, post-1987 (raw & flow adjusted).				
Total Dissolved Solids						↔	↔	No trends.				
Filterable Residue	↔	↔	↔			↔	↔	No trends.				
Potassium						↔	↔	No trends.				
Sodium	↔	↔	↑			↔	↔	Positive step in 1987.				
Calcium	↔	↓	↔			↔	↔	Declining overall trend, flow adjusted data.			1000[ls]	100
Magnesium	↔	↔	↔			↔	↔	No trends.				
Bicarbonate						↔	↔	No trends.				
Carbonate								Insufficient data.				
Chloride	↔	↓	↑			↔	↓	Declining post-1987 trend, flow adjusted data.			100-700[irr]	100
Fluoride						↔	↔	No trends.			1.0	100
Sulphate	↔	↔	↑			↔	↔	Positive step in 1987.				
Silica	↔	↔	↔			↔	↔	No trends.				
Total Organic Carbon	↔	↔	↔			↔	↔	No trends.				
Dissolved Organic Carbon			↓			↔	↔	Negative step in 1987.				

Table 7 Water quality trends and guideline comparisons of long-term routine variables data collected from the Athabasca River at Old Fort, 1977-2008 (continued).

Variable	Overall Trend	Overall, Flow Adjusted	1987 Step	Pre-1987 Trend	Pre-1987, Flow Adjusted	Post-1987 Trend	Post-1987, Flow Adjusted	Comments	ASWQG*	% Compliance	CCMEWQG**	% Compliance
Total Ammonia Nitrogen						↑	↔	Increasing post-1987 trend.			0.019[b]	100
Total Kjeldahl Nitrogen						↔	↔	No trends.				
Nitrite and Nitrate Nitrogen	↔	↔	↓			↑	↔	Increasing post-1987 trend.			100[ls]	100
Total Nitrogen	↔	↔	↓			↔	↔	Negative step in 1987.	1.0	88.8		
Total Phosphorus	↔	↑	↔			↔	↑	Increasing post-1987 trend, flow adjusted data.	0.05	54.8		
Total Dissolved Phosphorus						↔	↔	No trends.				
Chlorophyll a						↔	↔	No trends.				
Total Coliforms						↓	↔	Declining post-1987 trend.			1000/100ml[irr]	99.1
Fecal Coliforms								Insufficient data.	100/100 mL[c]	98.5	100/100ml[irr]	98.5
Escherichia coli								Insufficient data.	400/100mL[c]	100		

*ASWQG = Alberta Surface Water Quality Guideline

**CCMEWQG = Canadian Council of Ministers of the Environment Guideline

Unless otherwise indicated, presented ASWQG and CCMEWQG values relate to the protection of aquatic life.

[a]Chronic exposure guideline based on life stages of aquatic biota.

[b]Based on un-ionized ammonia fraction, which is calculated as a function of pH and water temperature.

[c]Based on Alberta River Water Quality Index objectives.

[ls]As determined for livestock consumption.

[irr]As determined for irrigation water.

↓ Declining trend, significant at a p-value of 0.05.

↑ Increasing trend, significant at a p-value of 0.05.

↔ - No significant trend at a p-value of 0.05. This includes significant trends with a slope of zero.

Crossed out cells indicate that the analysis was not performed. Reasons are explained in the methods section.

Table 8 Water quality trends and guideline comparisons of long-term metals data collected from the Athabasca River at Old Fort, 1960-2008. Only those metals with sufficient data for trend analysis are depicted here.

Variable	Overall Trend (1977-2002)	Overall, Flow Adjusted	1987 Step Trend	Pre-1987 Trend	Pre-1987, Flow Adjusted	Post-1987 Trend	Post-1987, Flow Adjusted	Comments	ASWQG*	CCMEWQG** (mg/L)	% Compliance
Total Aluminum						↑	↑	Increasing trend, after 1987 (raw & flow adjusted).		0.1[a]	13.0
Total Arsenic						NS	↑	Increasing trend in flow adjusted data, after 1987.		0.005	100.0
Total Barium						NS	NS	No trend.			
Total Copper						↓	NS	Decreasing trend, after 1987.		Calculated	100.0
Total Iron						NS	NS	No trend.		0.3	4.3
Total Molybdenum						↓	NS	Decreasing trend, after 1987.		0.073	100.0
Total Lead						NS	NS	No trend.		Calculated	60.9
Total Zinc						NS	NS	No trend.		0.03	95.2

*ASWQG = Alberta Surface Water Quality Guideline
**CCMEWQG = Canadian Council of Ministers of the Environment Guideline
Unless otherwise indicated, presented guideline values relate to the protection of aquatic life.

[a]Based on pH≥6.5 & $[Ca^{2+}]$>4 mg/L, DOC≥2 mg/L
↑ - Increasing trend, significant at a p-value of 0.05
↓ - Decreasing trend, significant at a p-value of 0.05
NS - Not Significant. Any trends not reporting significance at a p-value of 0.05.
Calculated = guideline is calculated individually for each sample, based on water hardness at time of sampling.

Table 9 Guideline comparisons for long-term routine variables data collected from the Athabasca River at all Alberta Environment water quality monitoring stations, 1960-2008.

upstream → downstream

	Guideline	Guideline Source	Hinton			Athabasca			Fort McMurray			Old Fort		
			# of Samples	Exceedances	Compliance (%)	# of Samples	Exceedances	Compliance (%)	# of Samples	Exceedances	Compliance (%)	# of Samples	Exceedances	Compliance (%)
pH	6.5-8.5	ASWQG	103	2	**98.1**	551	11	**98.0**	65	2	**96.9**	276	3	**98.9**
pH	6.5-9.0	CCME	103	0	**100**	551	4	**99.3**	65	0	**100**	276	1	**99.6**
Dissolved Oxygen (mg/L)	6.5	ASWQG	102	0	**100**	440	1	**99.8**	44	0	**100**	202	1	**99.5**
Dissolved Calcium (mg/L)	1000	[ls]CCME	103	0	**100**	519	0	**100**	64	0	**100**	272	0	**100**
Chloride (mg/L)	100-700	[irr]CCME	103	0	**100**	523	0	**100**	63	0	**100**	273	0	**100**
Fluoride (mg/L)	1.0	[irr]CCME	103	0	**100**	421	2	**99.5**	63	1	**98.4**	225	0	**100**
Ammonia Nitrogen (mg/L)	*0.019	CCME	103	0	**100**	342	1	**99.7**	64	0	**100**	433	0	**100**
Nitrate + Nitrite Nitrogenb (mg/L)	100	[ls]CCME	103	0	**100**	454	0	**100**	64	0	**100**	270	0	**100**
Total Nitrogen (mg/L)	1.0	ASWQG	103	0	**100**	362	19	**94.8**	64	4	**93.8**	268	30	**88.8**
Nitrite (mg/L)	0.06	CCME	101	0	**100**	109	0	**100**	63	0	**100**	151	1	**99.3**
Total Phosphorus (mg/L)	0.05	ASWQG	102	7	**93.1**	364	113	**69.0**	62	21	**66.1**	272	123	**54.8**
Total Coliforms (cells/100mL)	1000	[irr]CCME	1	0	**100**	224	8	**96.4**	1	0	**100**	113	1	**99.1**
Fecal Coliforms (cells/100mL)	100	[irr]CCME	102	0	**100**	341	6	**98.2**	61	3	**95.1**	195	3	**98.5**
E. coli (cells/100mL)	400	ARWQI	101	0	**100**	101	0	**100**	60	0	**100**	83	0	**100**

ASWQG - Surface Water Quality Guidelines for use in Alberta
CCME - Canadian Council of Ministers of the Environment

[ls]Guideline for livestock consumption
[irr]Guideline for irrigation water
*Un-ionized fraction

Table 10 Guideline comparisons for metals data collected from the Athabasca River at all Alberta Environment water quality monitoring stations. Due to historical changes in analytical methodology and method detection limits, some guideline exceedances seen in older data may not have been included here.

upstream → downstream

	Guideline (mg/L)	Guideline Source	Hinton			Athabasca			Fort McMurray			Old Fort		
			# of Samples	Exceedances	Compliance (%)	# of Samples	Exceedances	Compliance (%)	# of Samples	Exceedances	Compliance (%)	# of Samples	Exceedances	Compliance (%)
Total Aluminum	0.1	CCME	34	27	**20.6**	85	43	**49.4**	22	15	**31.8**	80	50	**37.5**
Total Arsenic	0.005	CCME	34	0	**100**	50	1	**98.0**	22	0	**100**	50	0	**100**
Total Cadmium	Calc	CCME	19	1	**94.7**	19	9	**52.6**	19	7	**63.2**	20	14	**30.0**
Hexavalent Chromium	0.001	CCME	19	2	**89.5**	18	2	**88.9**	27	5	**81.5**	19	7	**63.2**
Total Copper	Calc	CCME	34	4	**88.2**	85	36	**57.6**	22	9	**59.1**	82	46	**43.9**
Total Iron	0.3	CCME	33	20	**39.4**	80	46	**42.5**	22	14	**36.4**	79	76	**3.8**
Total Lead	Calc	CCME	34	1	**97.1**	61	8	**86.9**	22	3	**86.4**	59	9	**84.7**
Total Molybdenum	0.073	*CCME	34	0	**100**	49	0	**100**	22	0	**100**	50	0	**100**
Total Nickel	Calc	CCME	34	0	**100**	49	0	**100**	22	0	**100**	50	0	**100**
Total Selenium	0.001	CCME	19	0	**100**	19	1	**94.7**	19	1	**94.7**	20	0	**100**
Total Silver	0.0001	CCME	20	1	**95.0**	20	1	**95.0**	20	1	**95.0**	21	1	**95.2**
Total Thallium	0.0008	CCME	19	0	**100**	19	0	**100**	19	0	**100**	20	0	**100**
Total Zinc	0.03	CCME	32	0	**100**	79	10	**87.3**	21	2	**90.5**	69	5	**92.8**

CCME - Canadian Council of Ministers of the Environment
Calc - Calculated based on measured hardness of individual samples
*Interim guideline

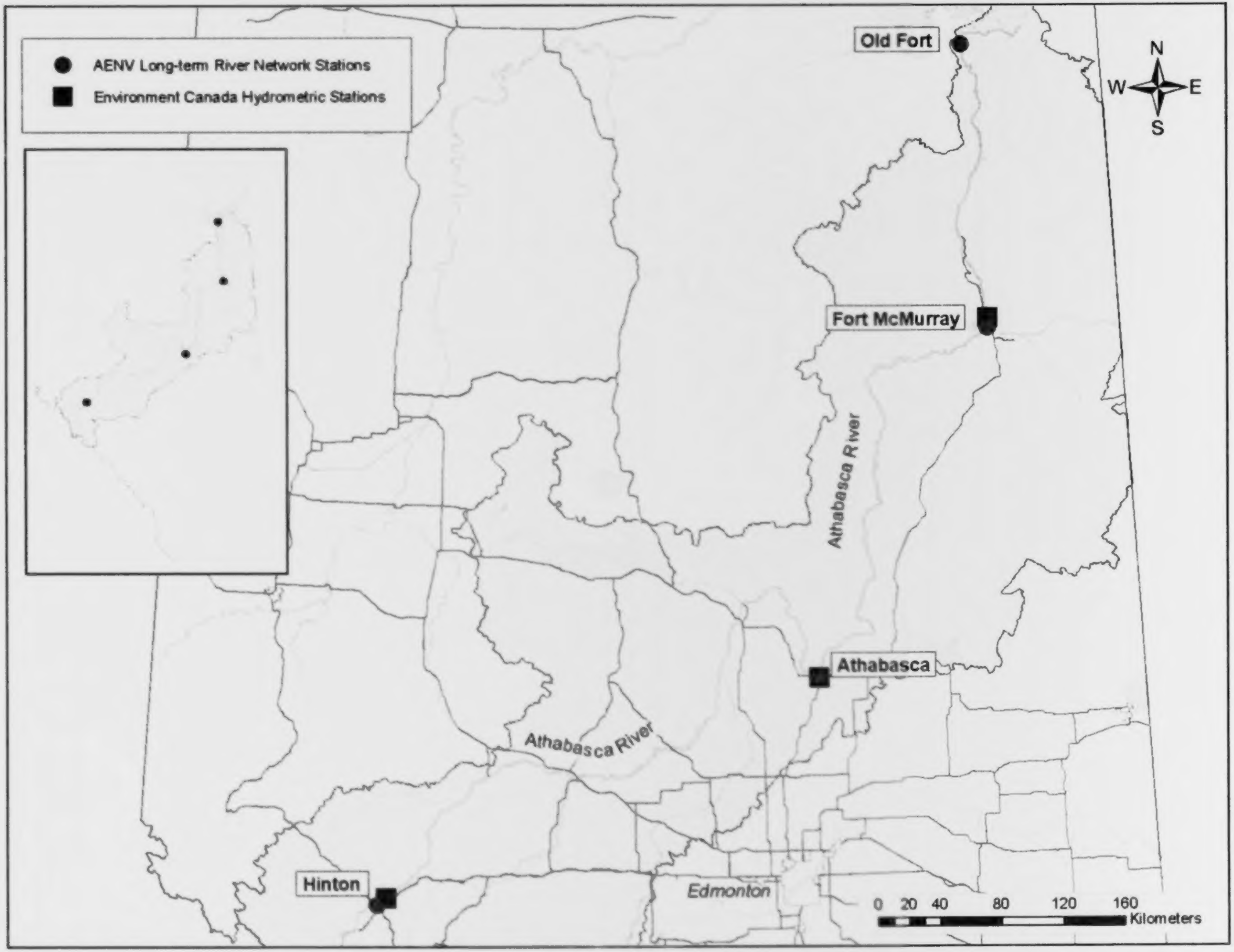


Figure 1 Long-Term River Network monitoring stations situated on the Athabasca River in Northern Alberta.

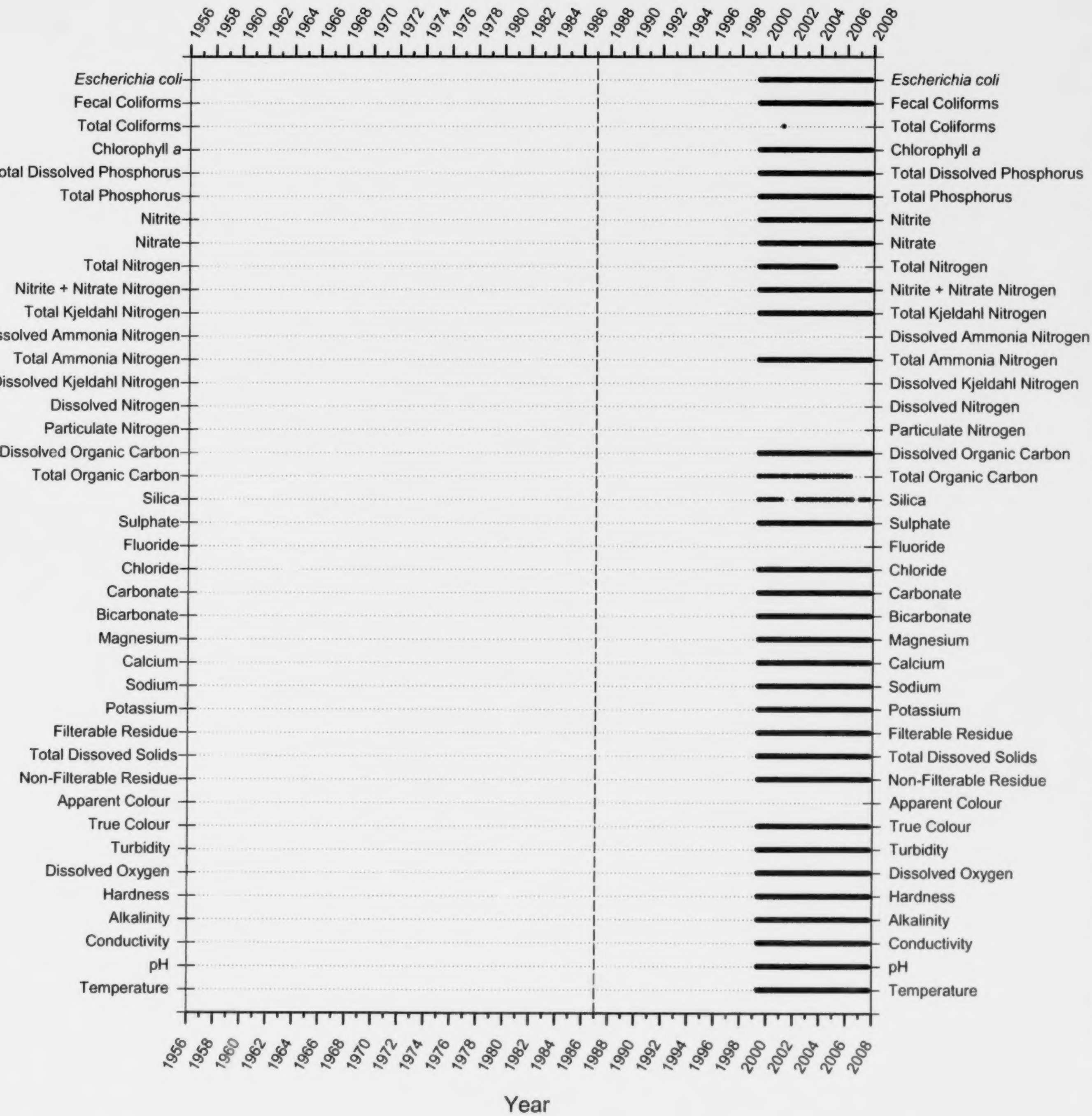


Figure 2 Data continuity for routine water quality variables sampled in the Athabasca River at the Hinton site. Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

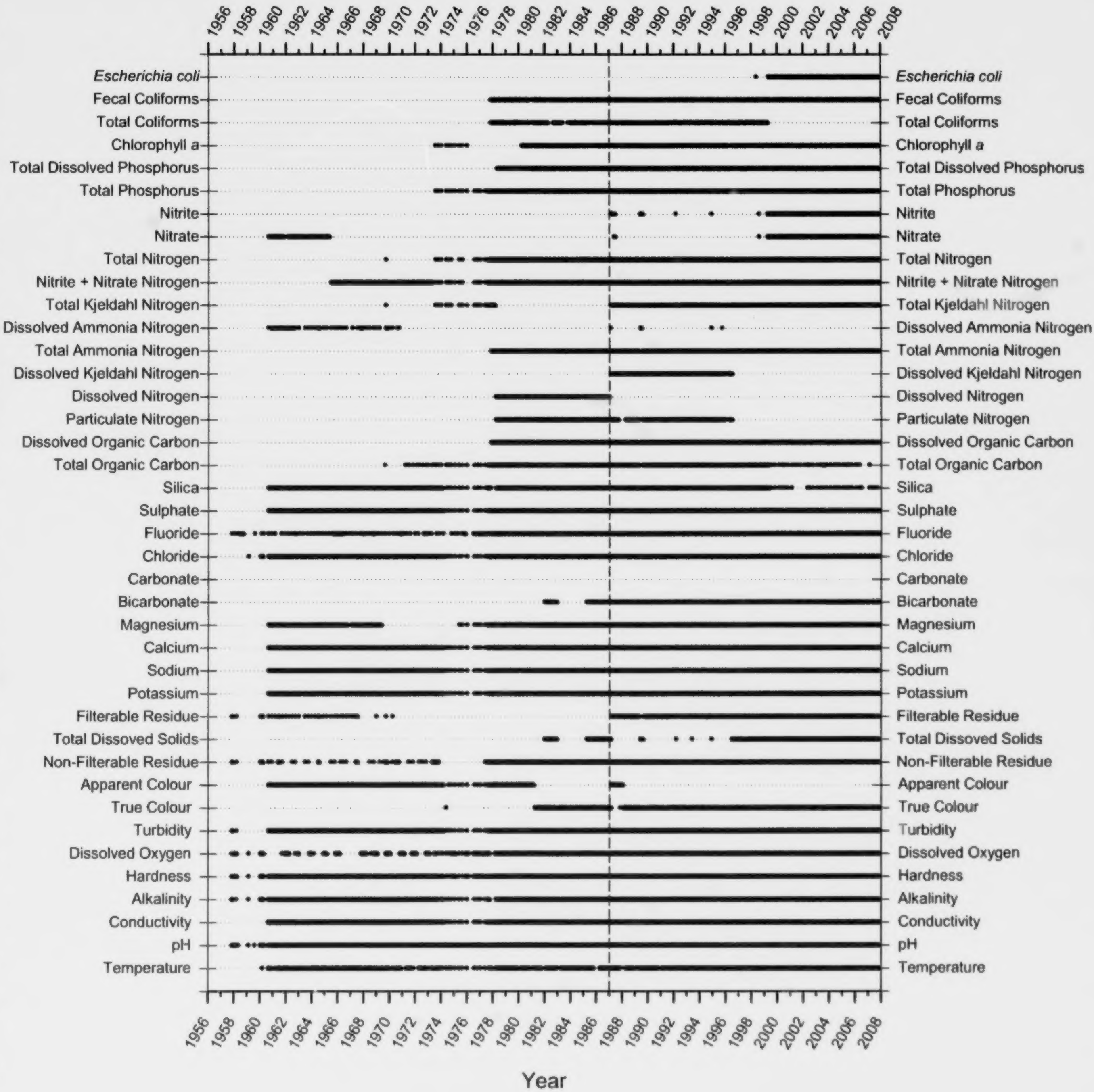


Figure 3 Data continuity for routine water quality variables sampled in the Athabasca River at the Athabasca site. Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

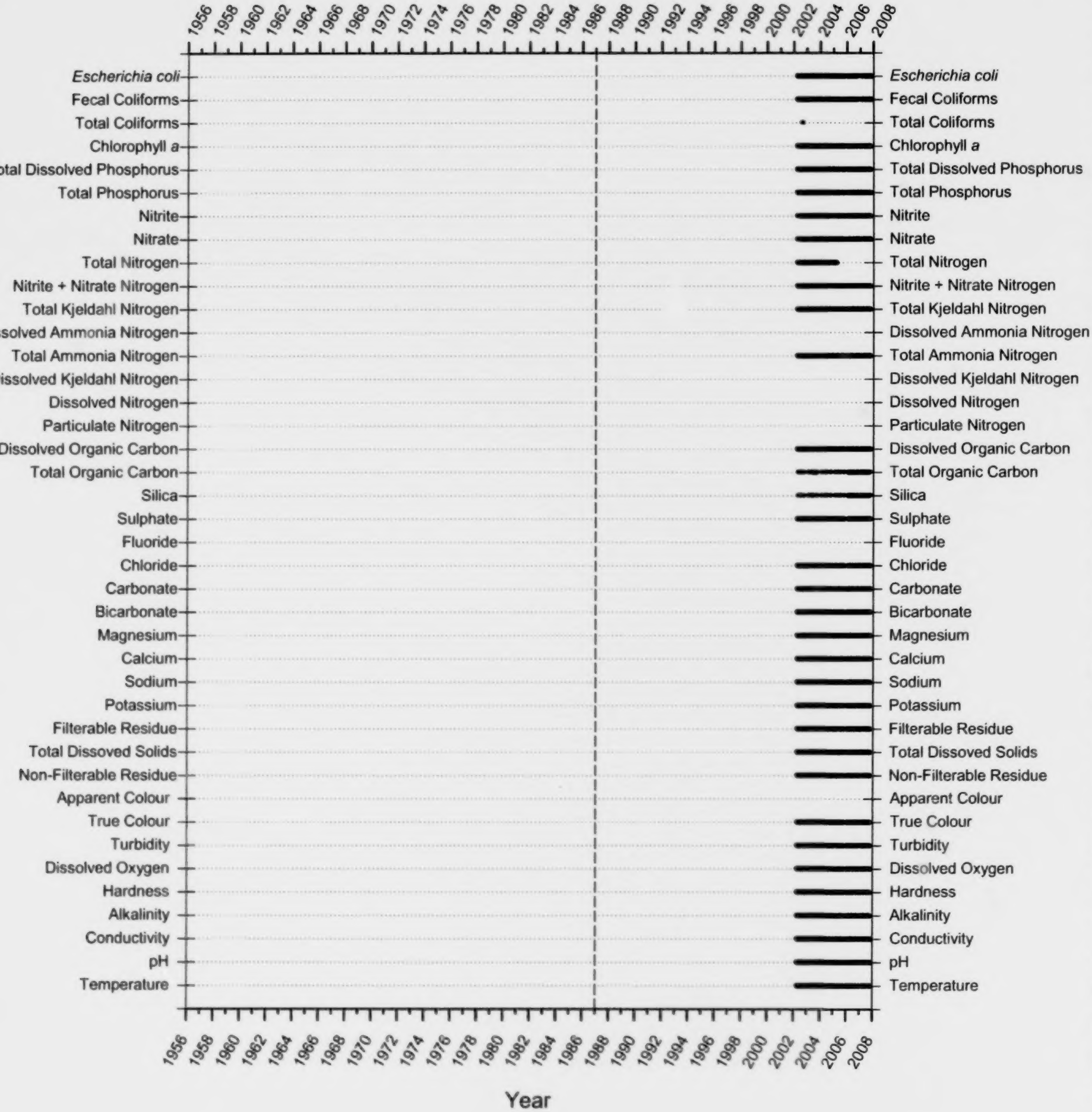


Figure 4 Data continuity for routine water quality variables sampled in the Athabasca River at the Fort McMurray site. Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

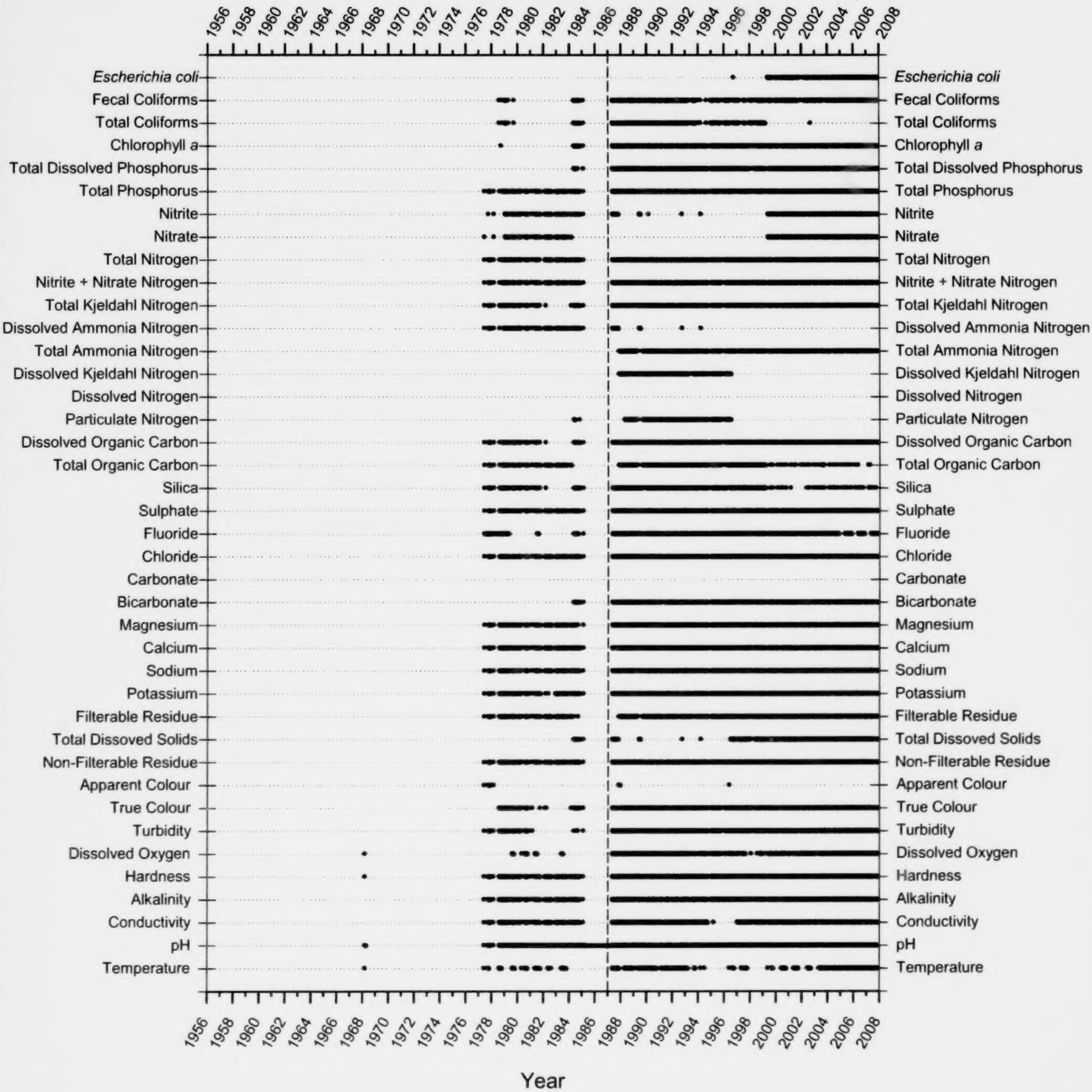


Figure 5 Data continuity for routine water quality variables sampled in the Athabasca River at the Old Fort site. Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

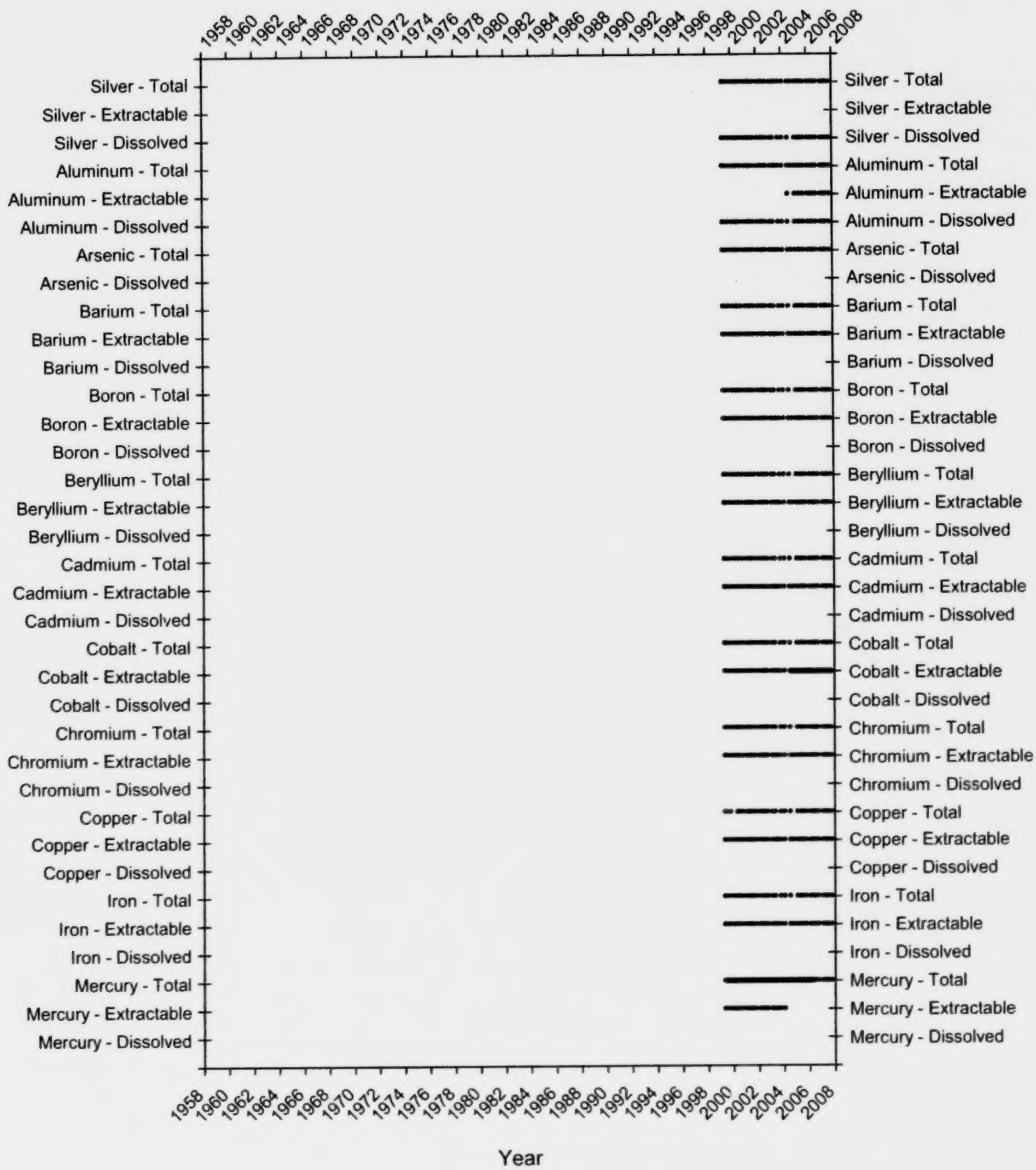


Figure 6 Data continuity for metal fractions sampled in the Athabasca River at the Hinton site. Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

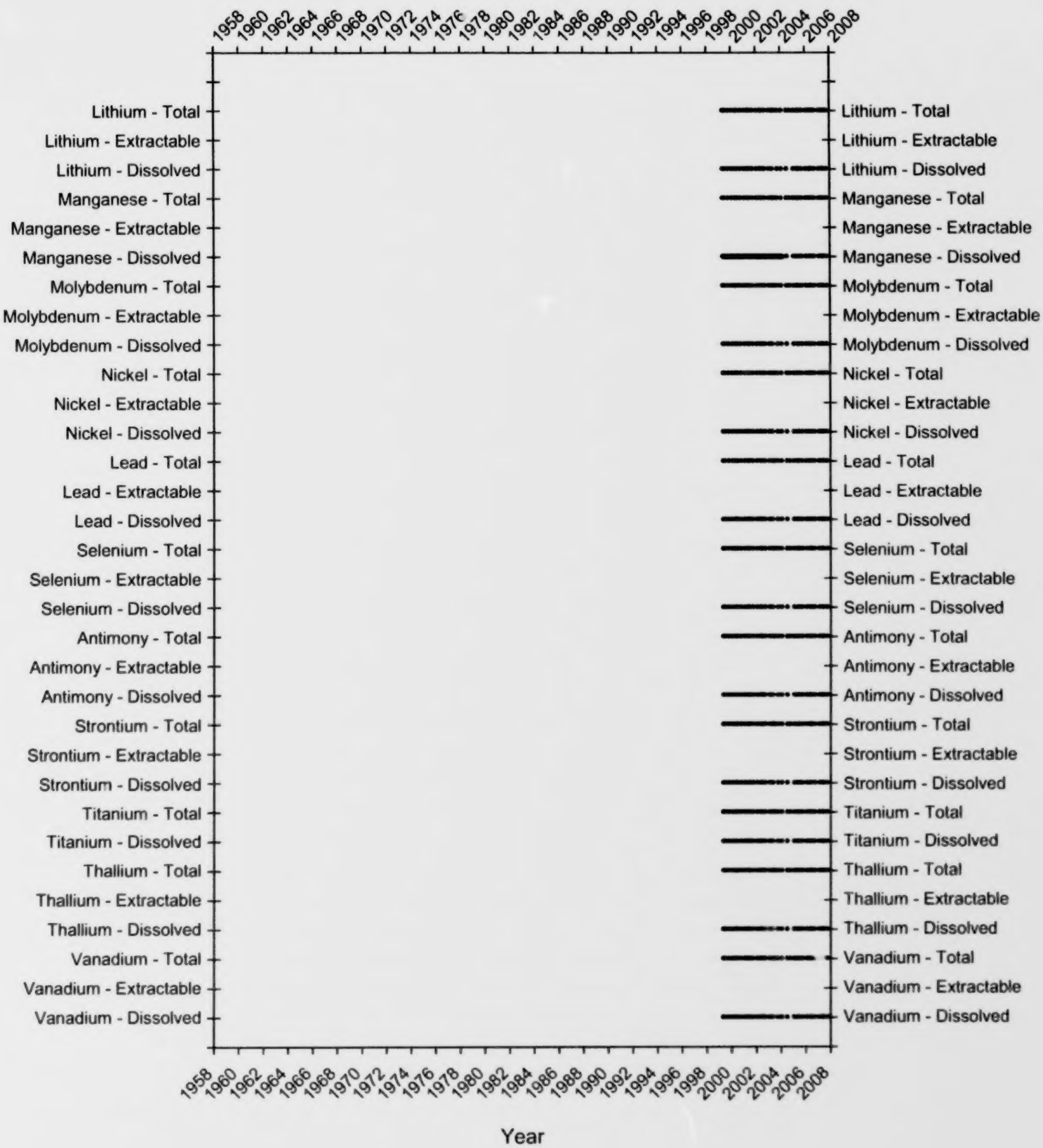


Figure 6 Data continuity for metal fractions sampled in the Athabasca River at the Hinton site (continued). Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

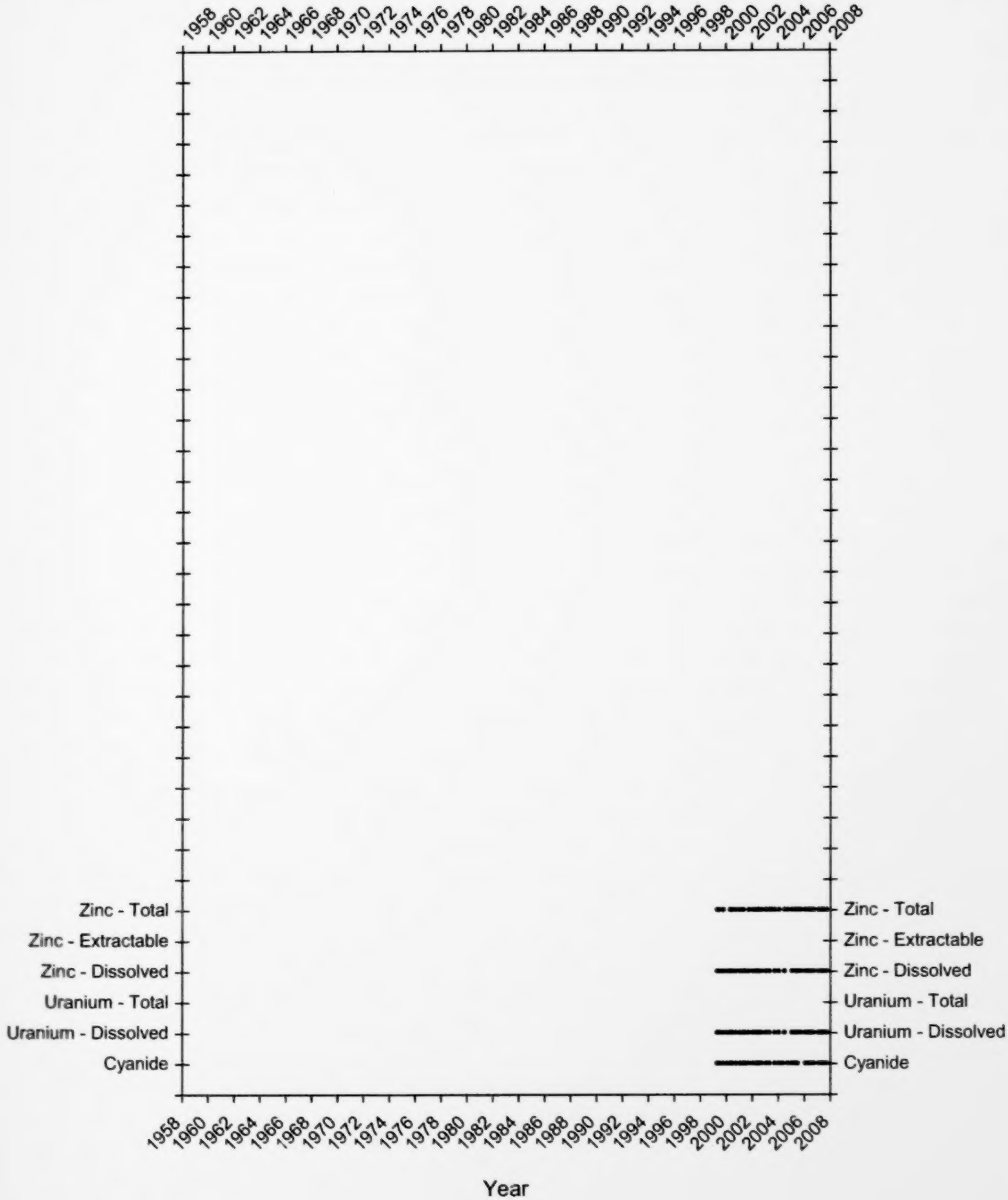


Figure 6 Data continuity for metal fractions sampled in the Athabasca River at the Hinton site (continued). Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

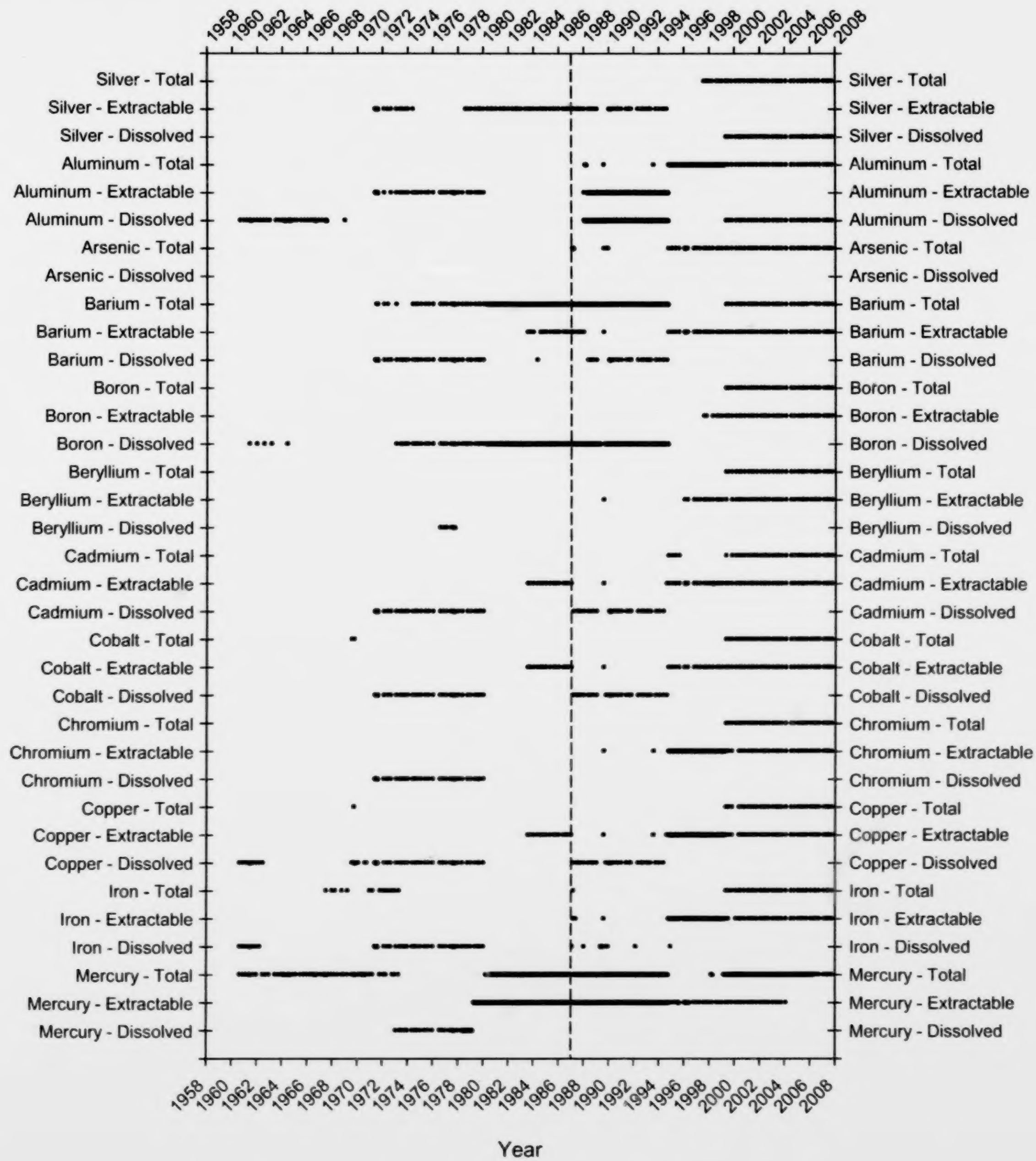


Figure 7 Data continuity for metal fractions sampled in the Athabasca River at the Athabasca site. Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

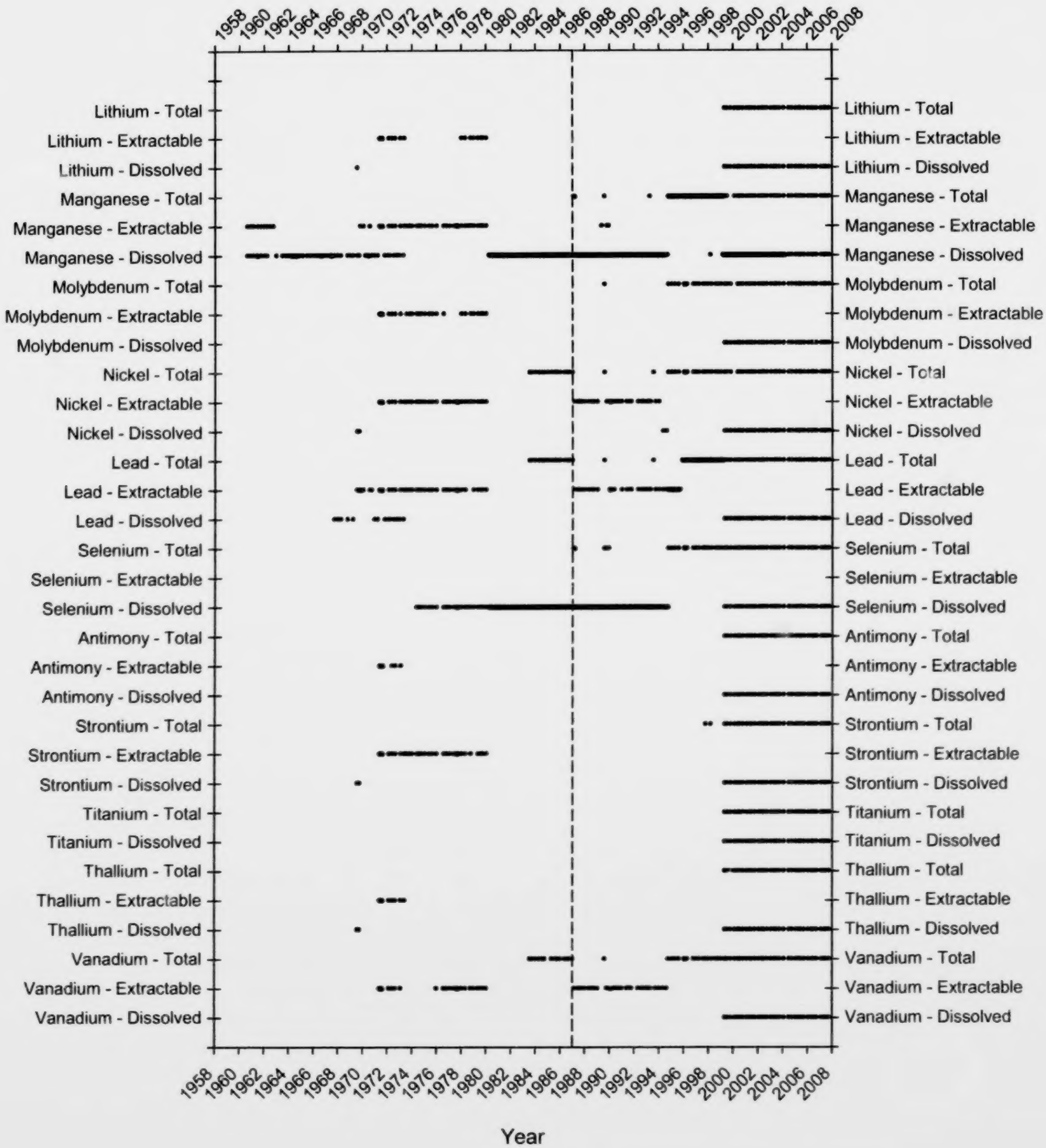


Figure 7 Data continuity for metal fractions sampled in the Athabasca River at the Athabasca site (continued). Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

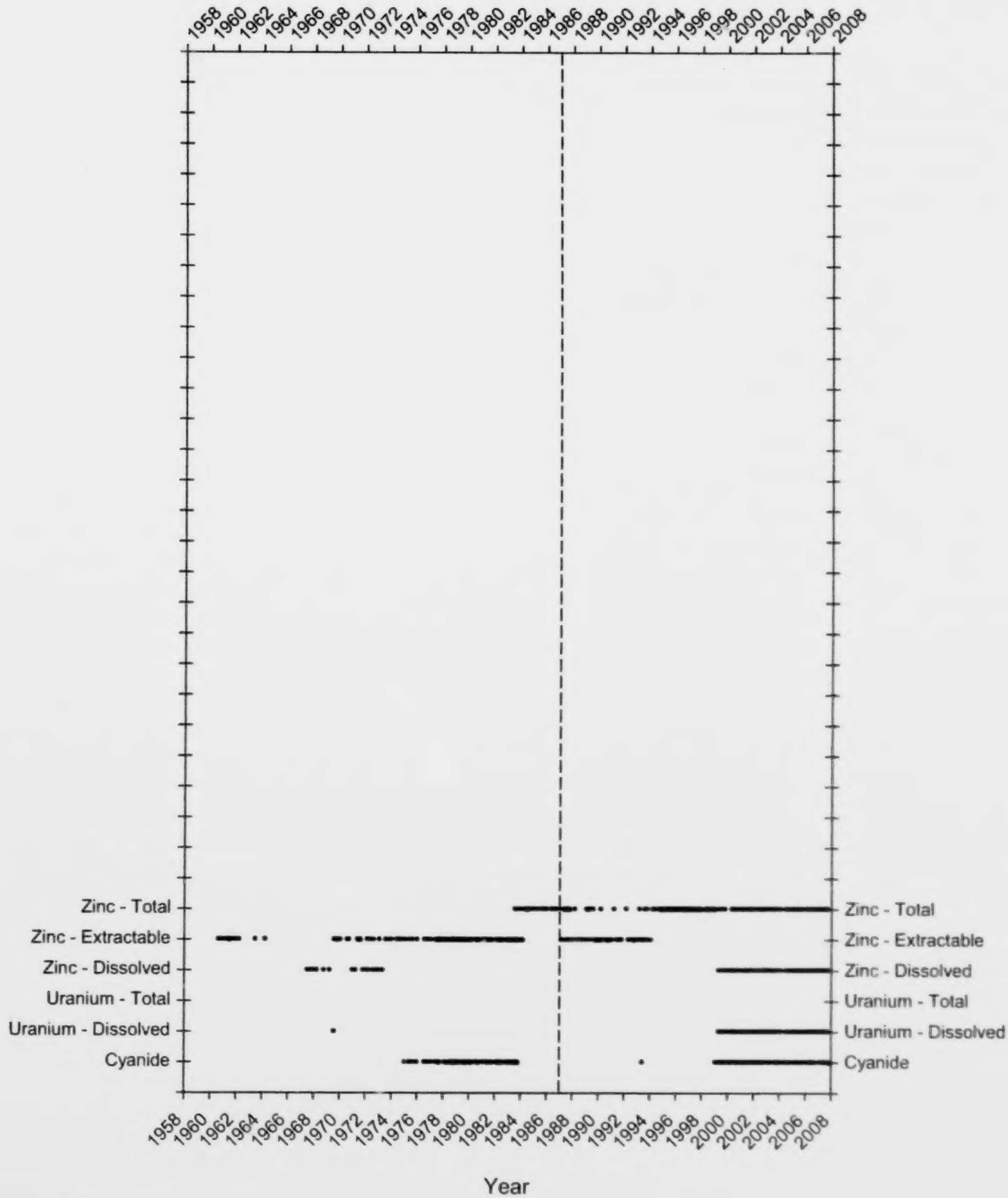


Figure 7 Data continuity for metal fractions sampled in the Athabasca River at the Athabasca site (continued). Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

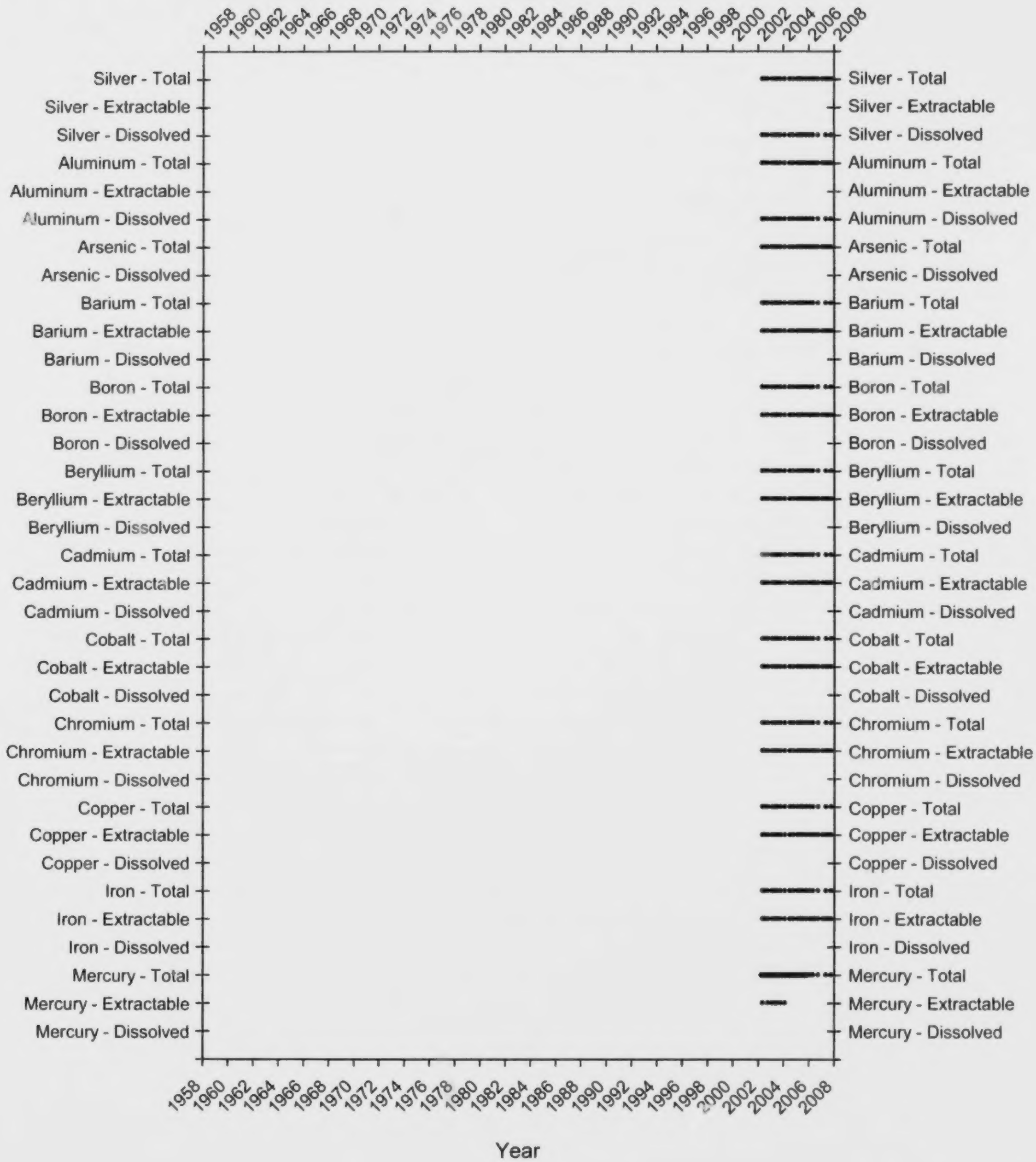


Figure 8 Data continuity for metal fractions sampled in the Athabasca River at the Fort McMurray site. Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

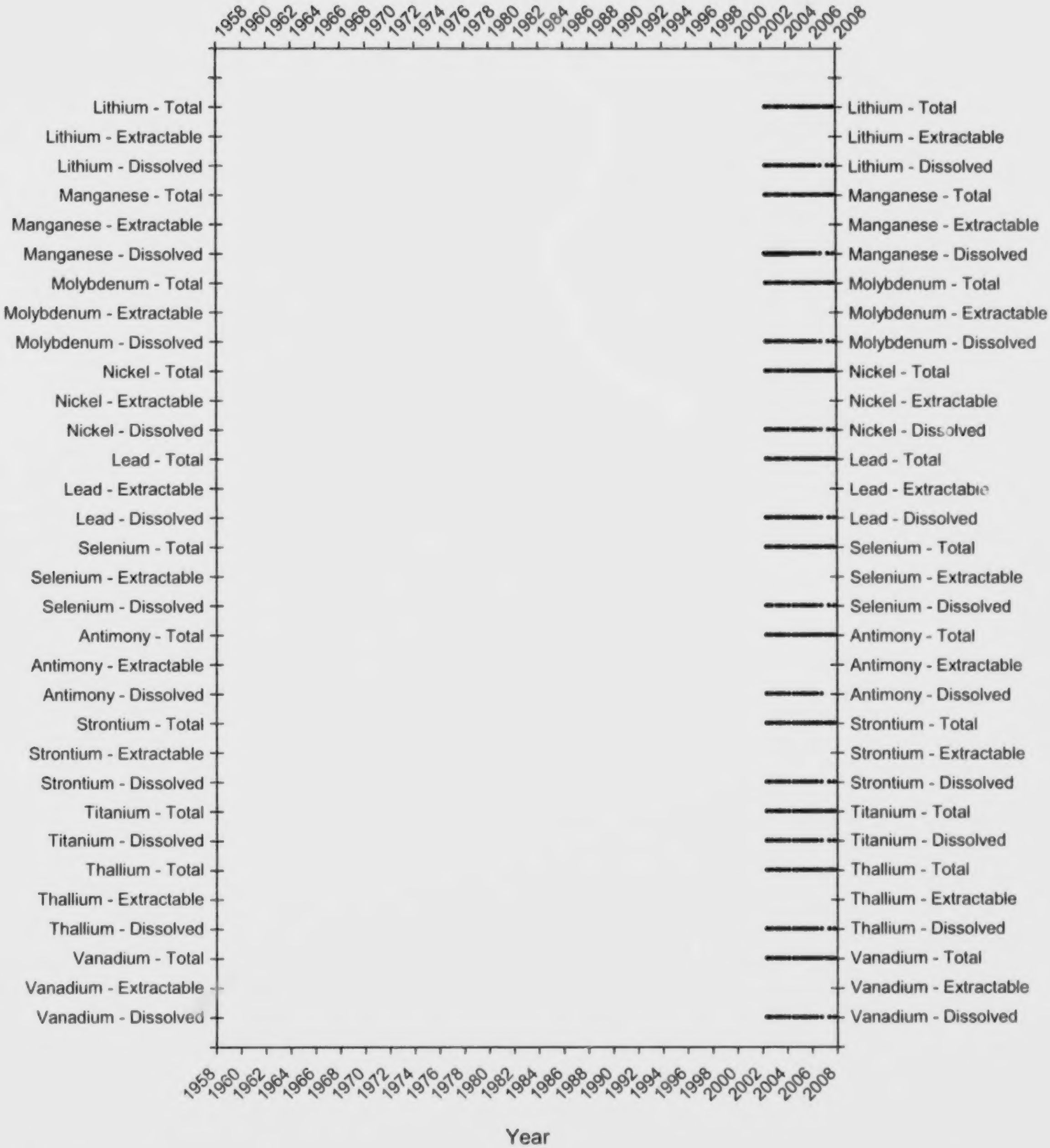


Figure 8 Data continuity for metal fractions sampled in the Athabasca River at the Fort McMurray site (continued). Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

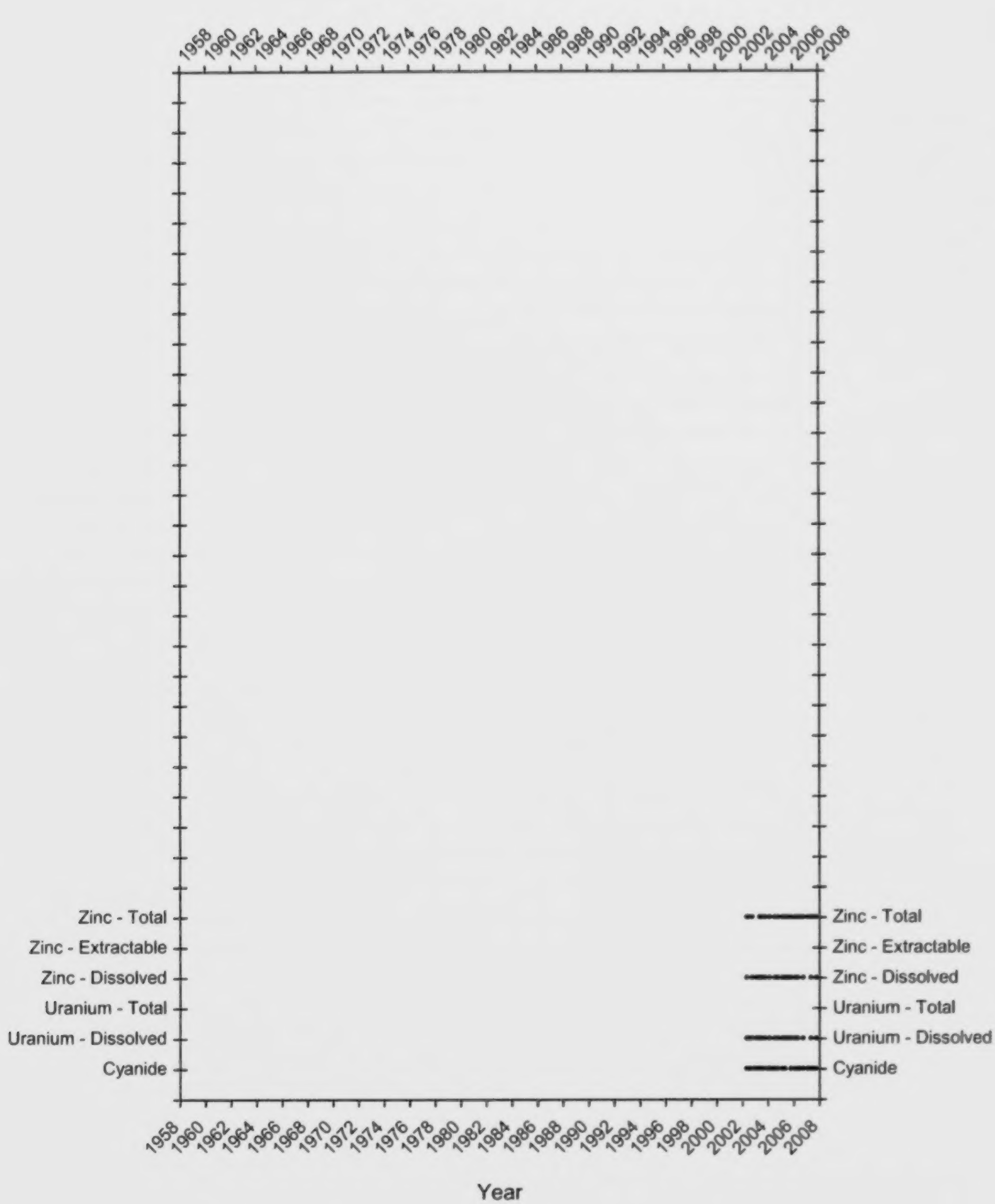


Figure 8 Data continuity for metal fractions sampled in the Athabasca River at the Fort McMurray site (continued). Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

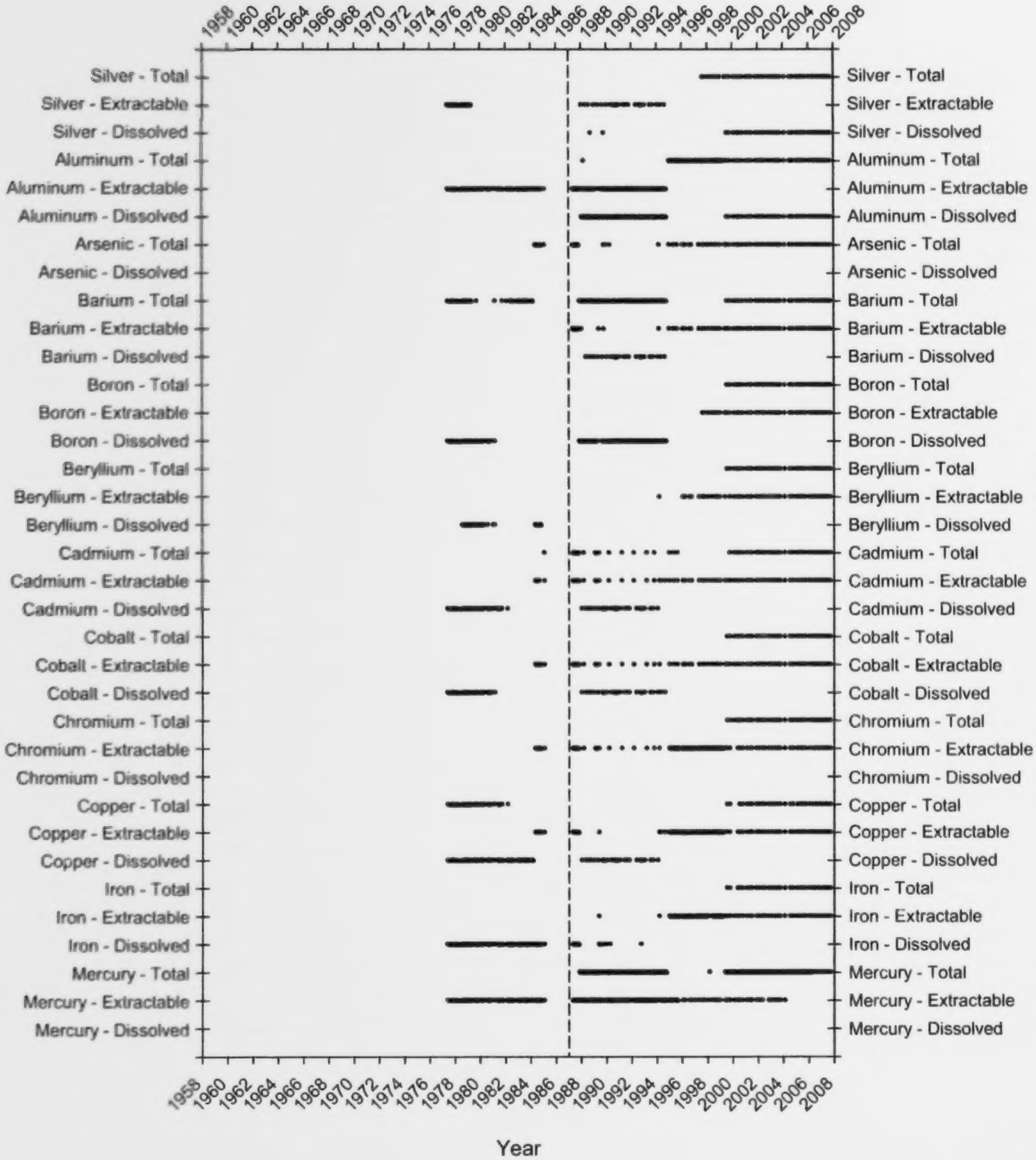


Figure 9 Data continuity for metal fractions sampled in the Athabasca River at the Old Fort site. Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

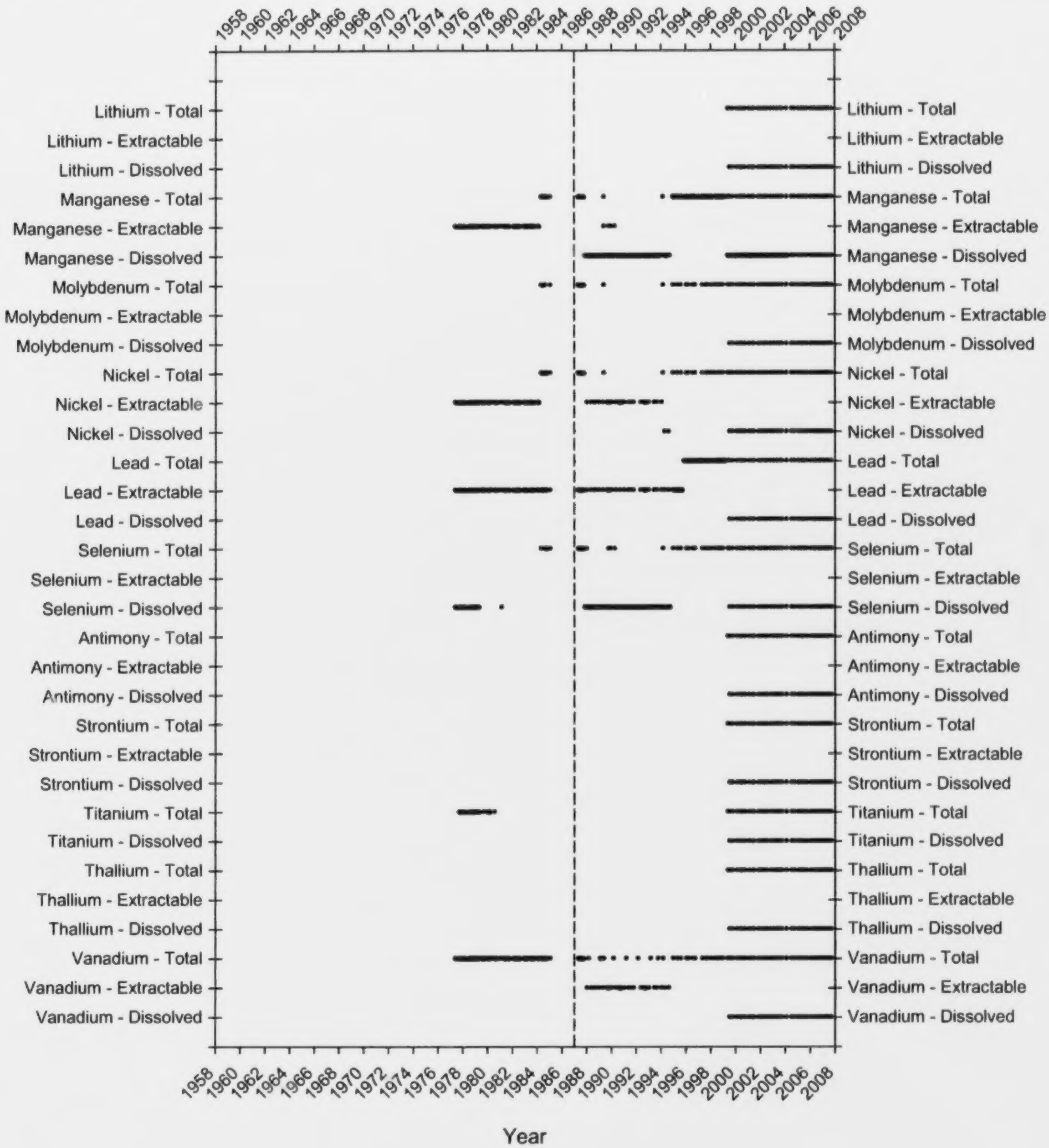


Figure 9 Data continuity for metal fractions sampled in the Athabasca River at the Old Fort site (continued). Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

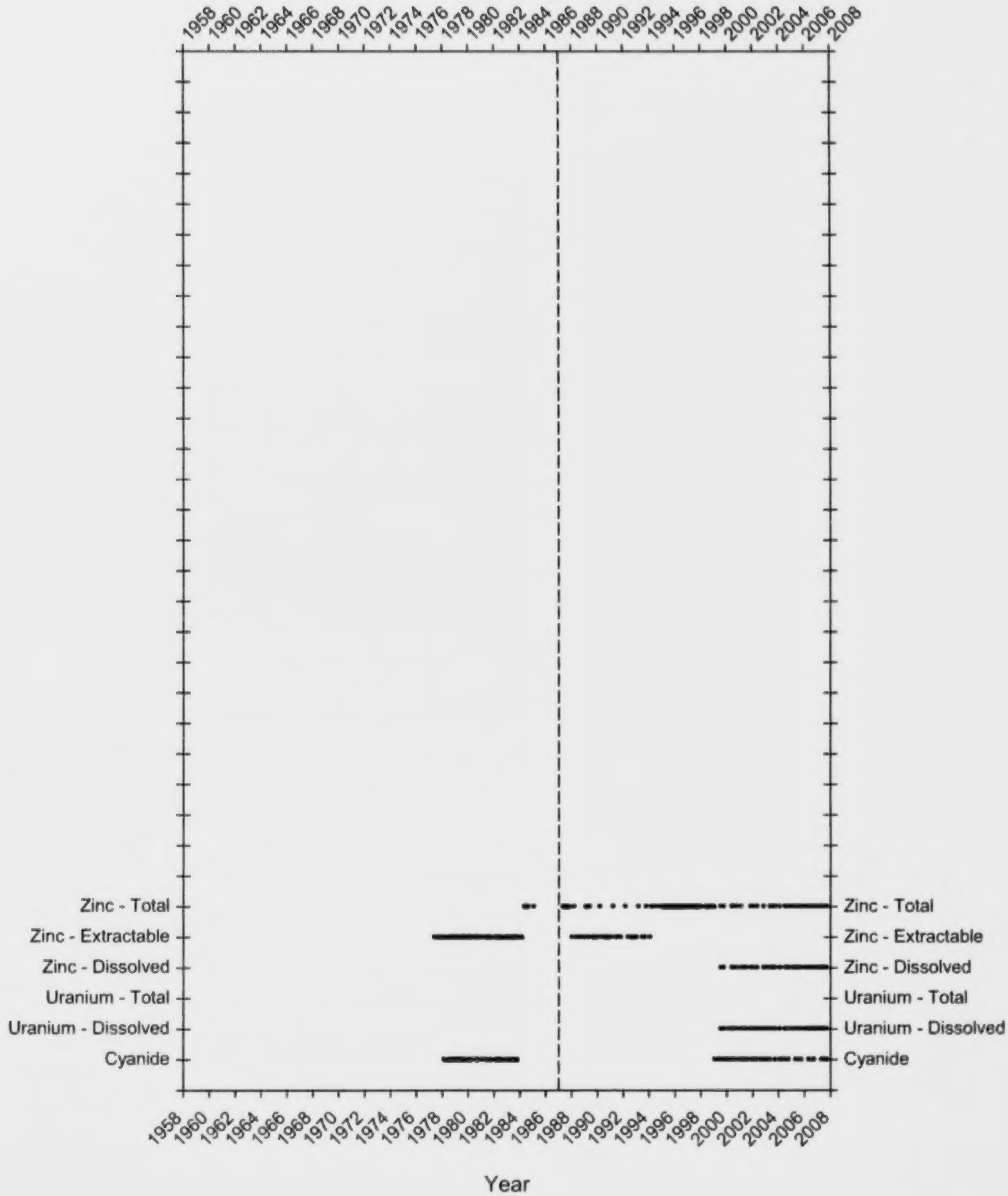


Figure 9 Data continuity for metal fractions sampled in the Athabasca River at the Old Fort site (continued). Each point on the graph represents a measured value for the associated variable at that point in time. The hashed vertical line represents a change in sampling agencies (from Environment Canada to Alberta Environment).

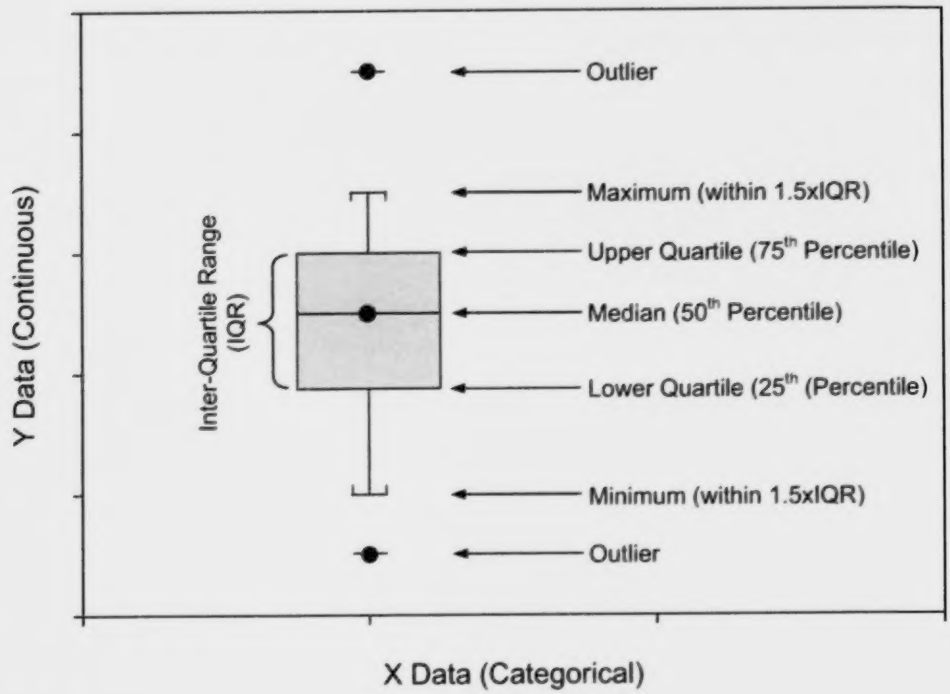


Figure 10 Key to box and whisker plot components.

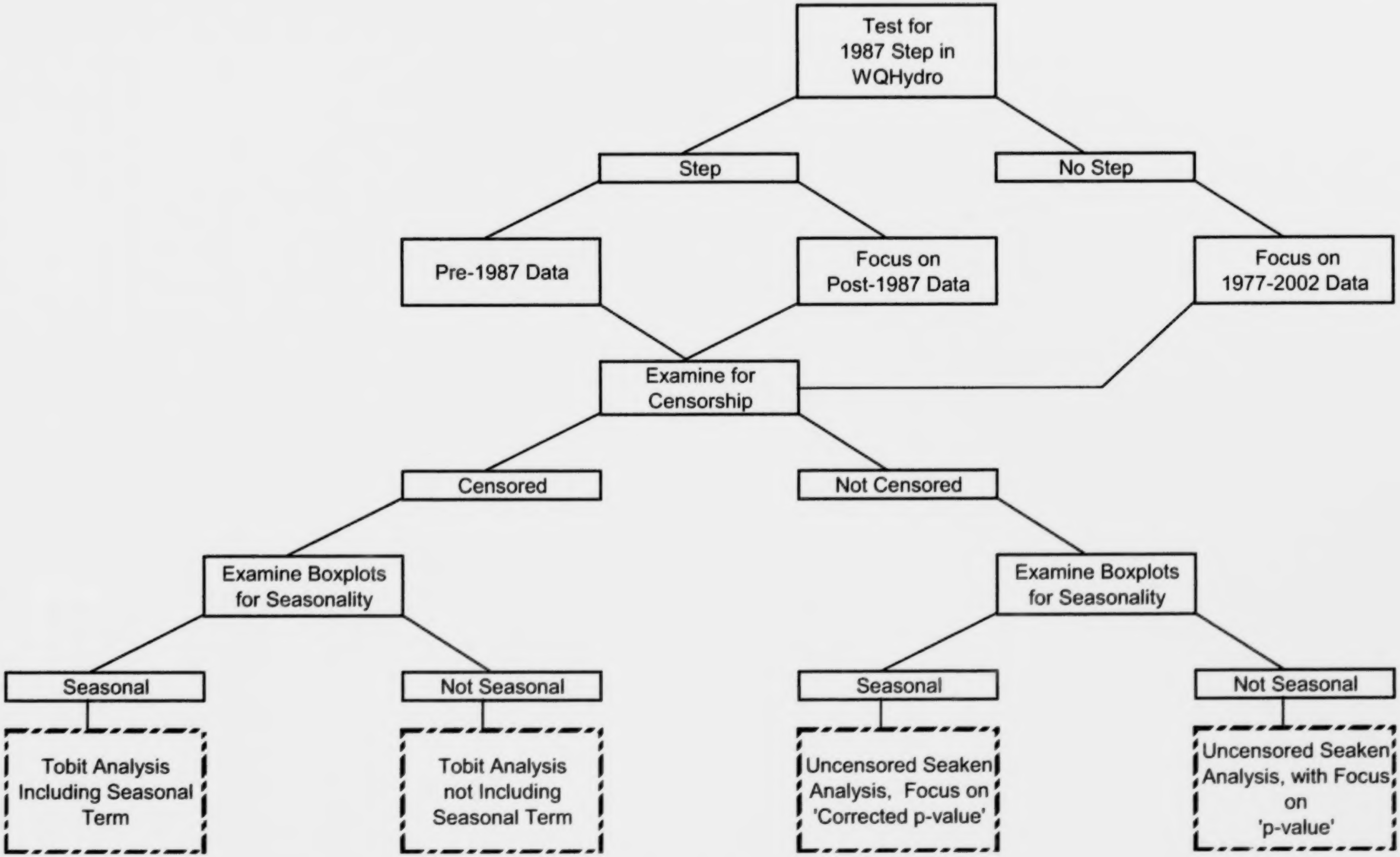
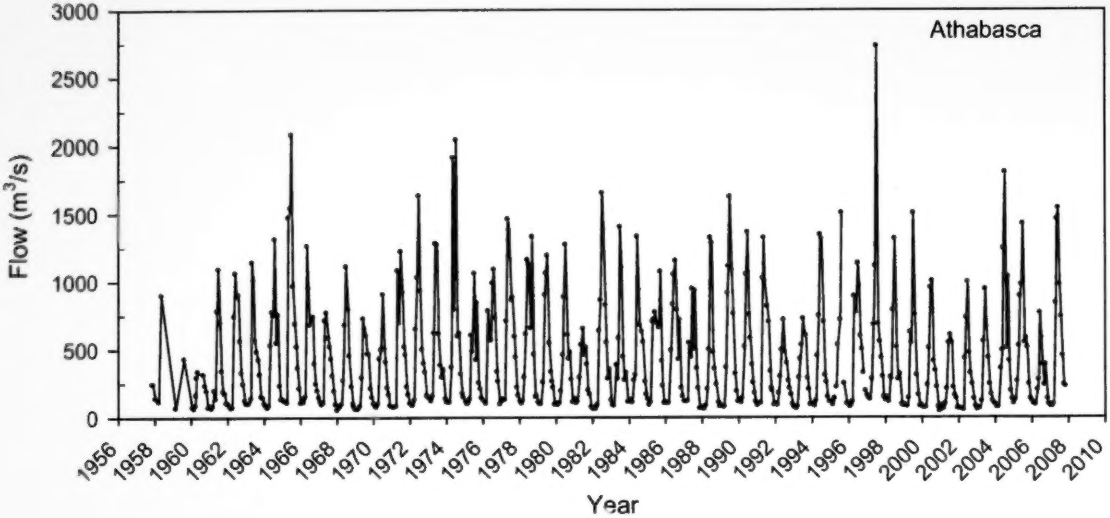
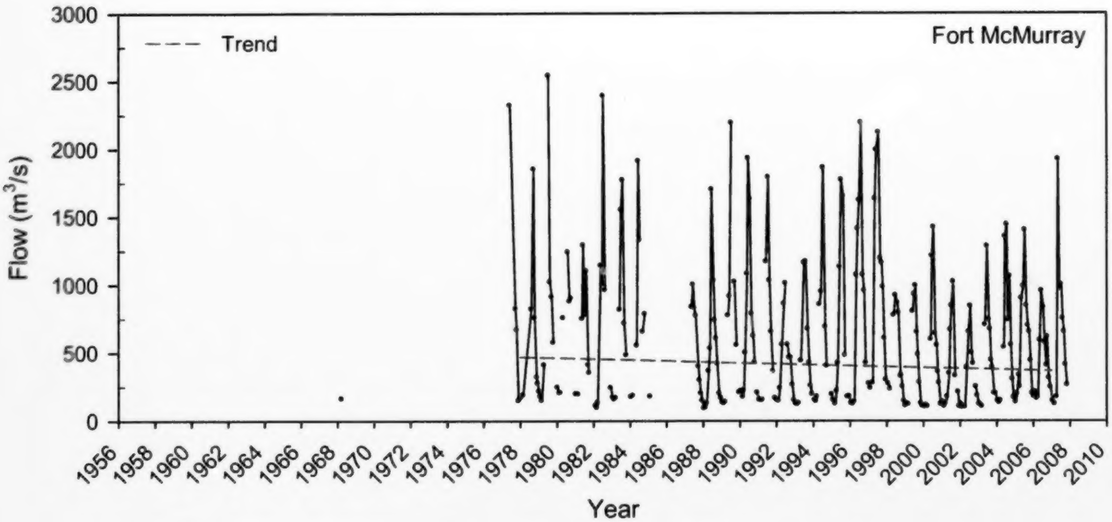


Figure 11 Flow diagram depicting the process used to identify the appropriate trend analysis to apply for each variable at each long-term sampling location. Trends were examined on pre-1987, post-1987, and complete data for all variables. In cases where the direction of a significant step coincided with the direction of a significant trend in overall data, the overall trend was negated.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
-0.5000	NS							
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
-3.4667	down							
Flow Adjusted								

Figure 12 Stream flow in the Athabasca River at Athabasca and Fort McMurray. Trends are significant at a minimum 95% confidence interval. Depicted values correspond to water quality sampling dates and do not incorporate the full suite of available hydrometric data. Comprehensive flow data are presented in Figures 247-249.

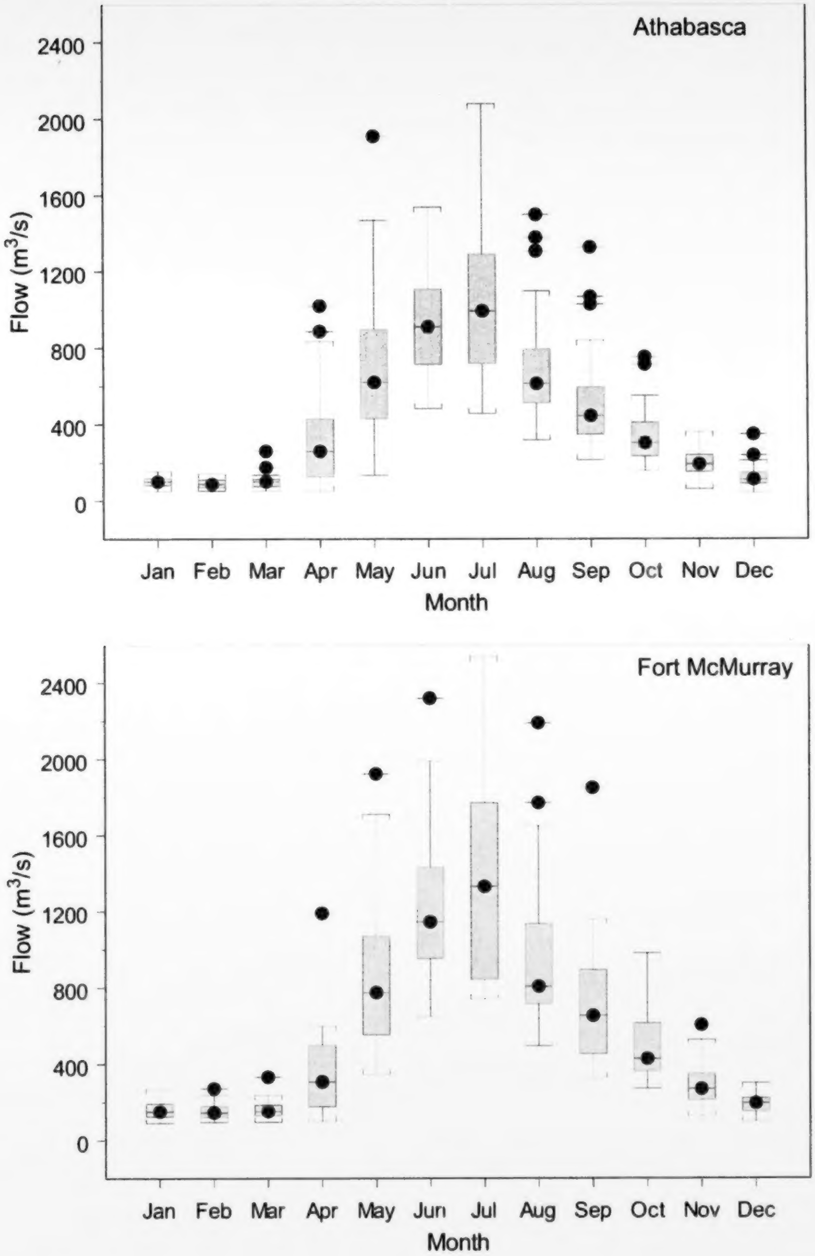
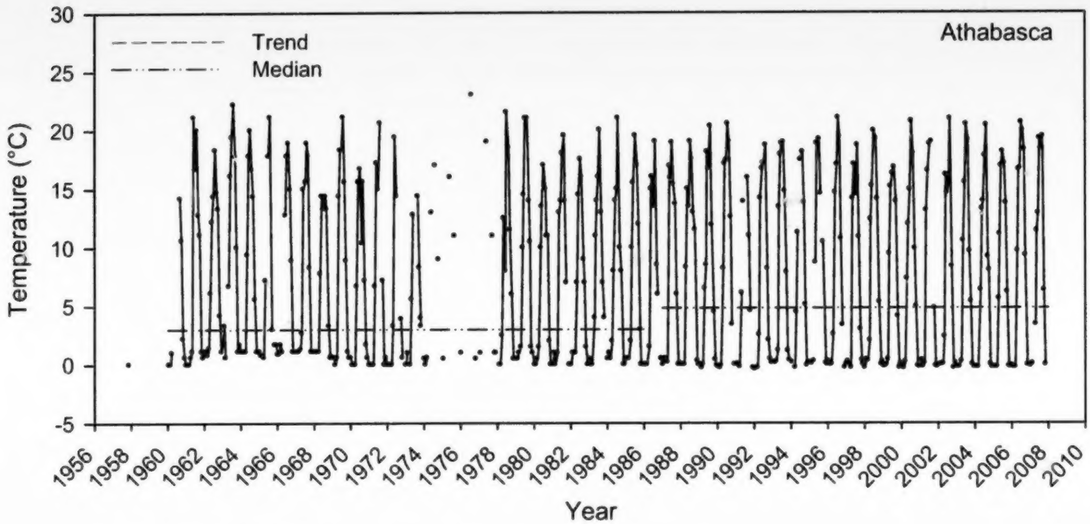
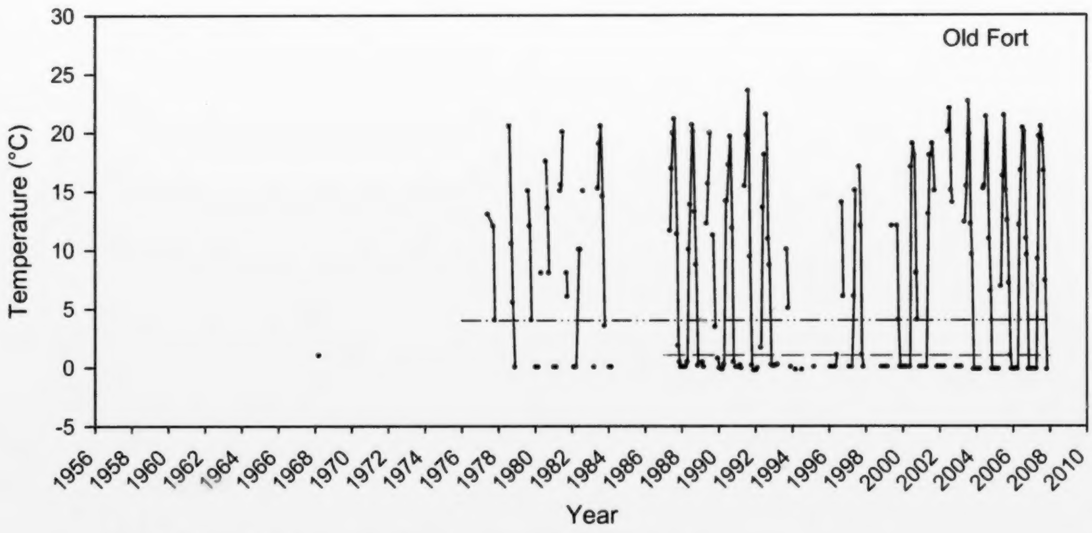


Figure 13 Seasonality of flow in the Athabasca River at Athabasca and Old Fort. Flow data utilized for these figures correspond to actual sampling dates. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
-0.0179	down	down	3.00	-0.0250	down	4.81	-0.0093	NS
Flow Adjusted								
0.0041	NS			-0.0954	down		0.0443	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0000	NS	NS	8.00	ID	ID	1.60	-0.0028	down
Flow Adjusted								
0.0458	NS			ID	ID		0.0327	NS

Figure 14 Water temperature in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

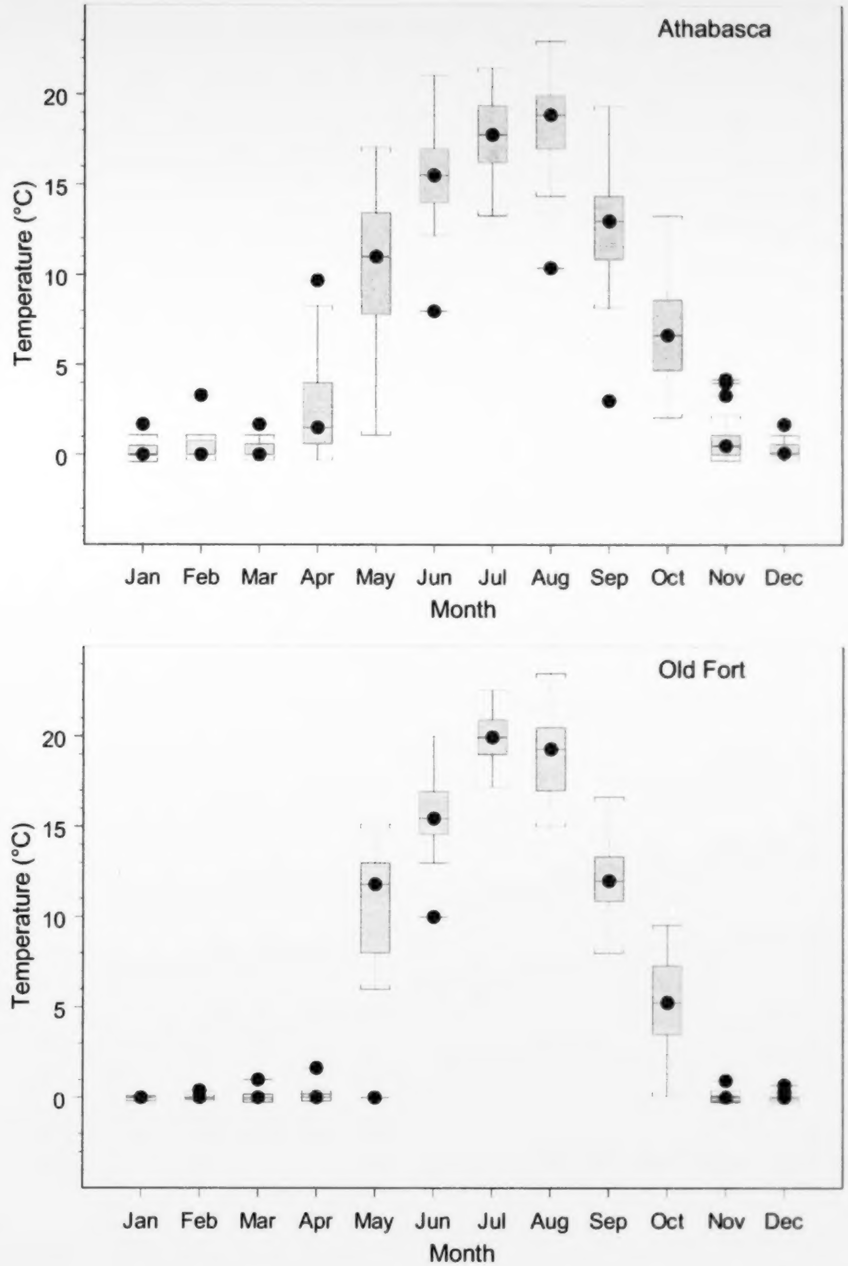
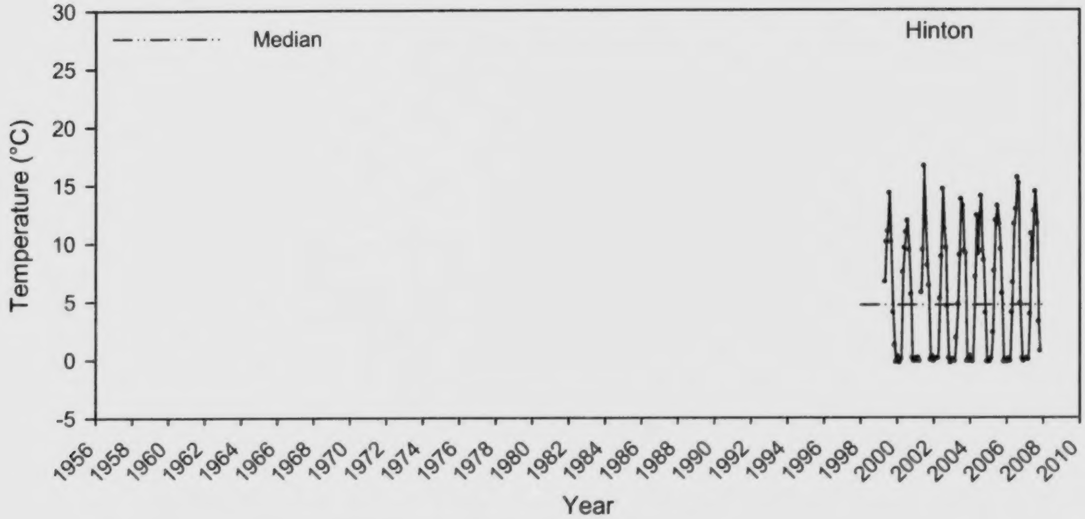
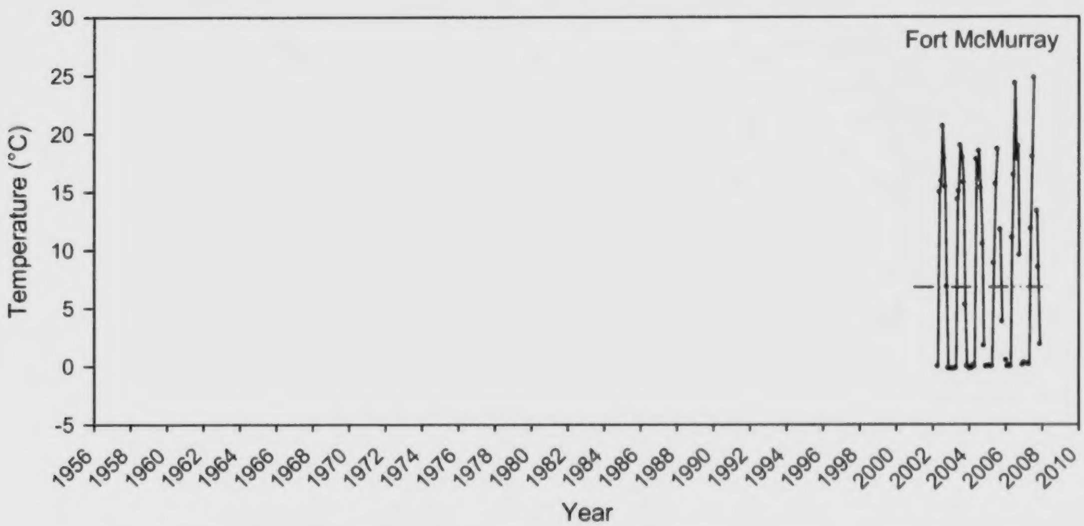


Figure 15 Seasonality of water temperature in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						4.66		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						6.77		
Flow Adjusted								

Figure 16 Water temperature in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

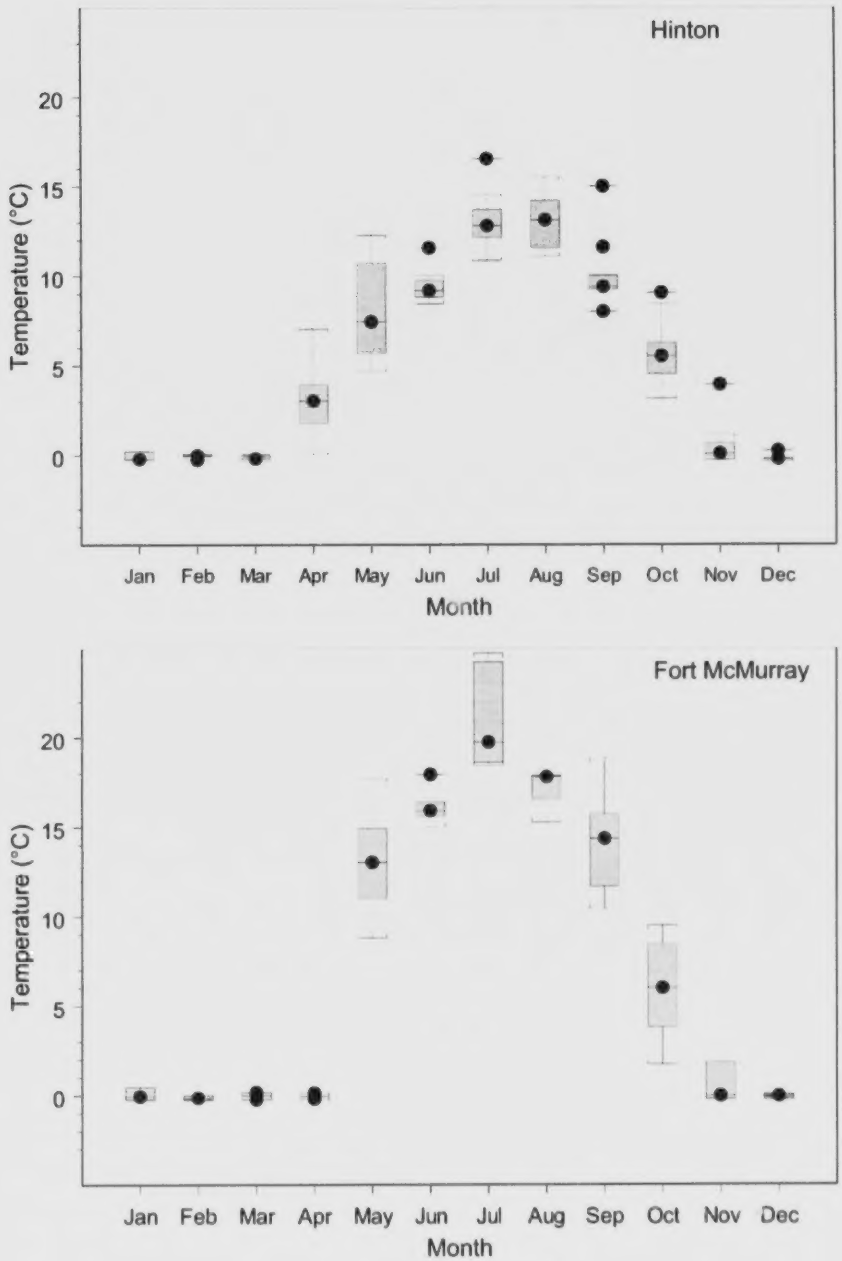
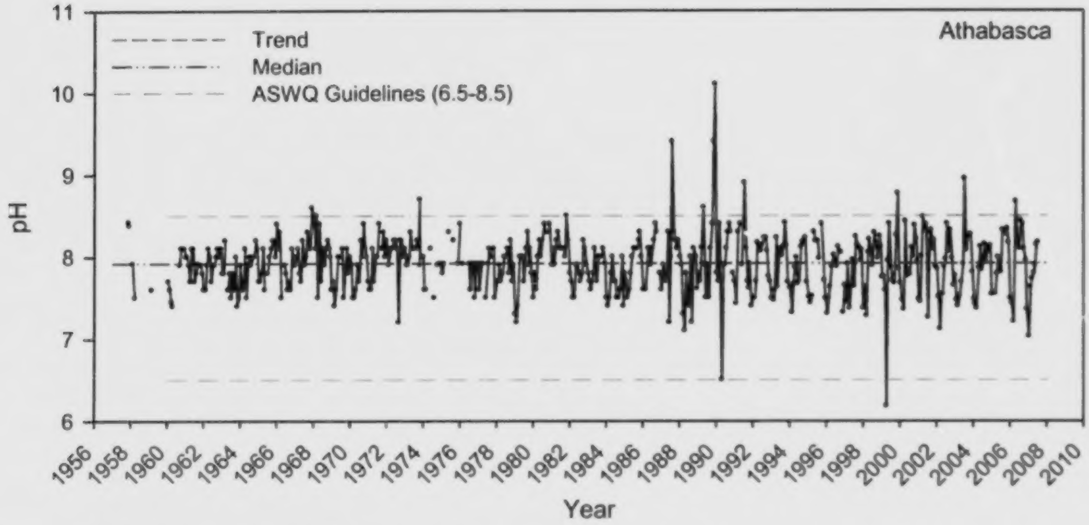
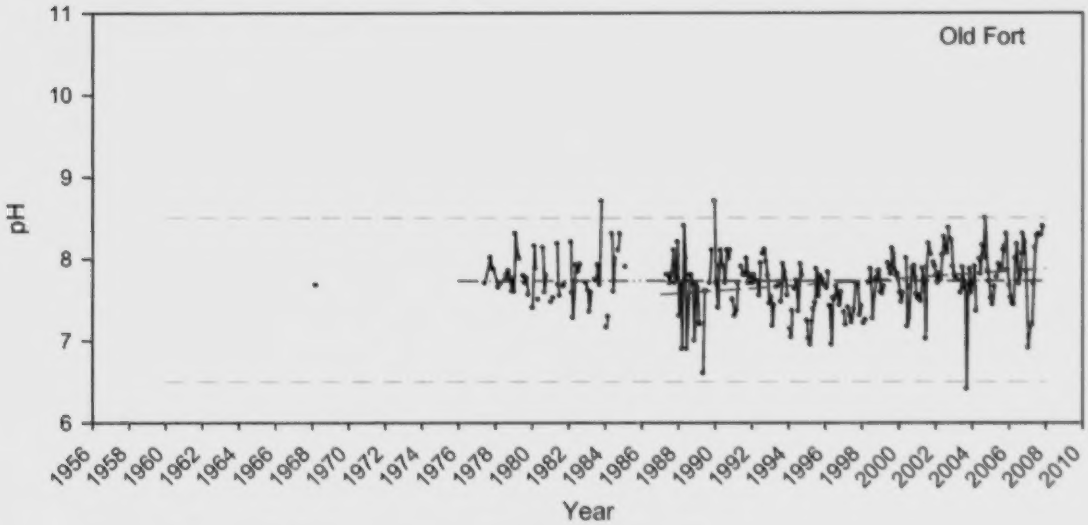


Figure 17 Seasonality of water temperature in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0000	NS	NS	7.92	0.0000	NS	7.91	0.0000	NS
Flow Adjusted								
-0.0003	NS			-0.0006	NS		0.0005	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0050	NS	NS	7.75	ID	ID	7.72	0.0150	up
Flow Adjusted								
0.0063	NS			ID	ID		0.0150	up

Figure 18 pH in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., p<0.05). ID = Insufficient Data, NS = Not Significant.

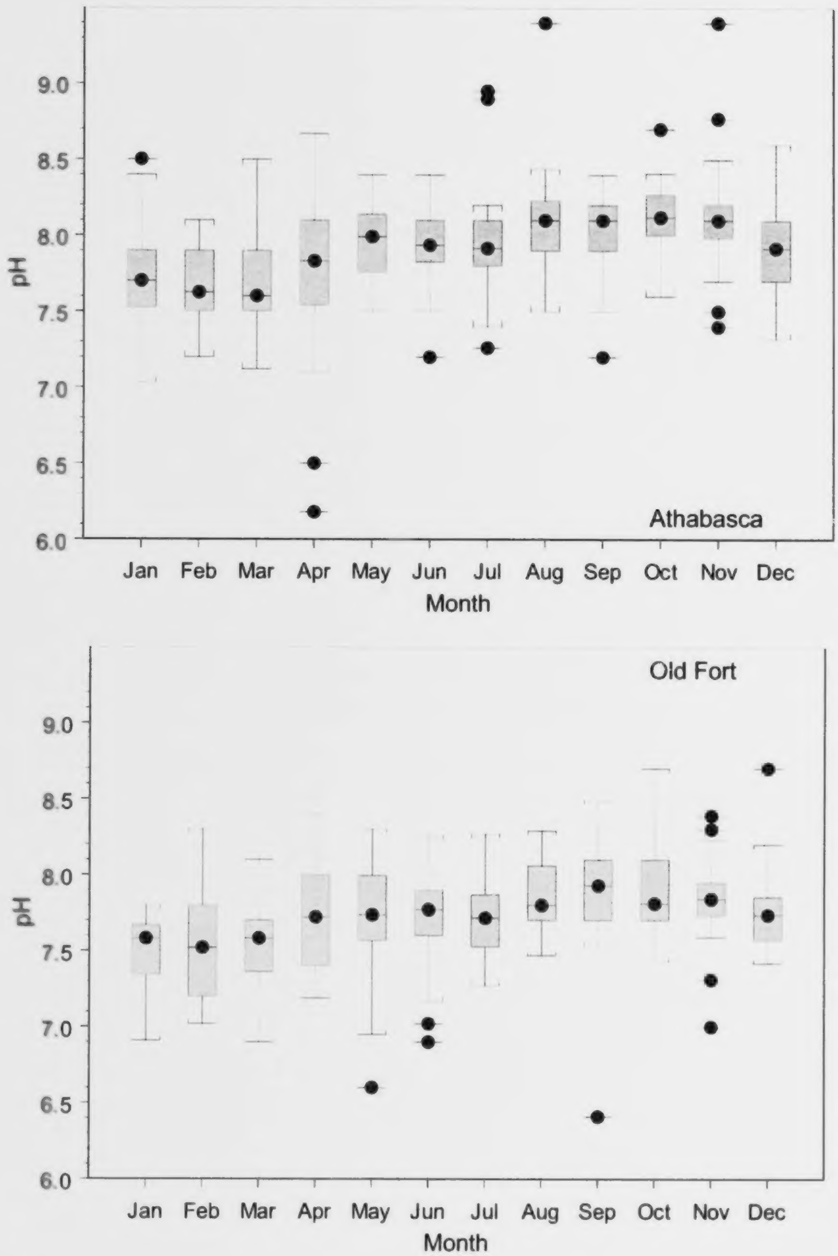
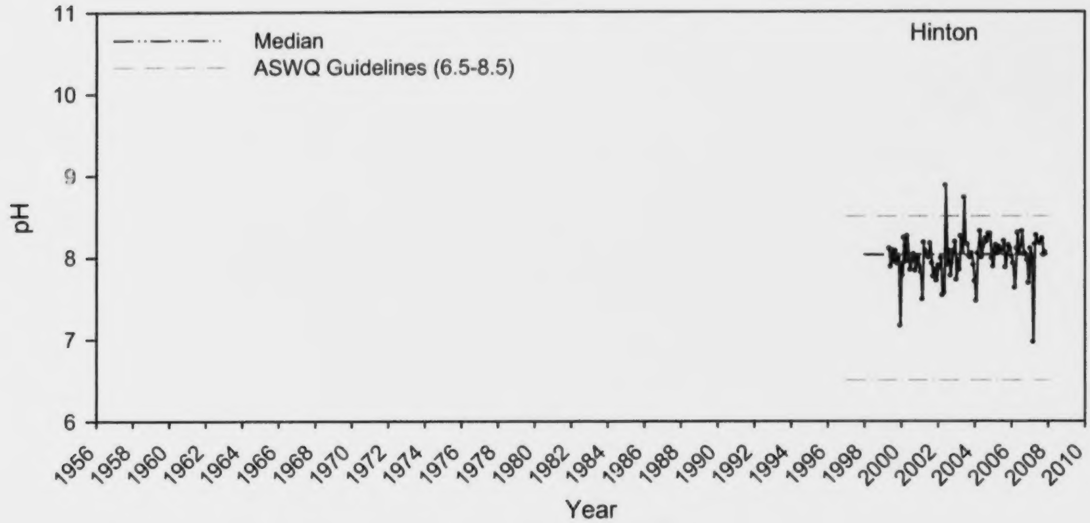
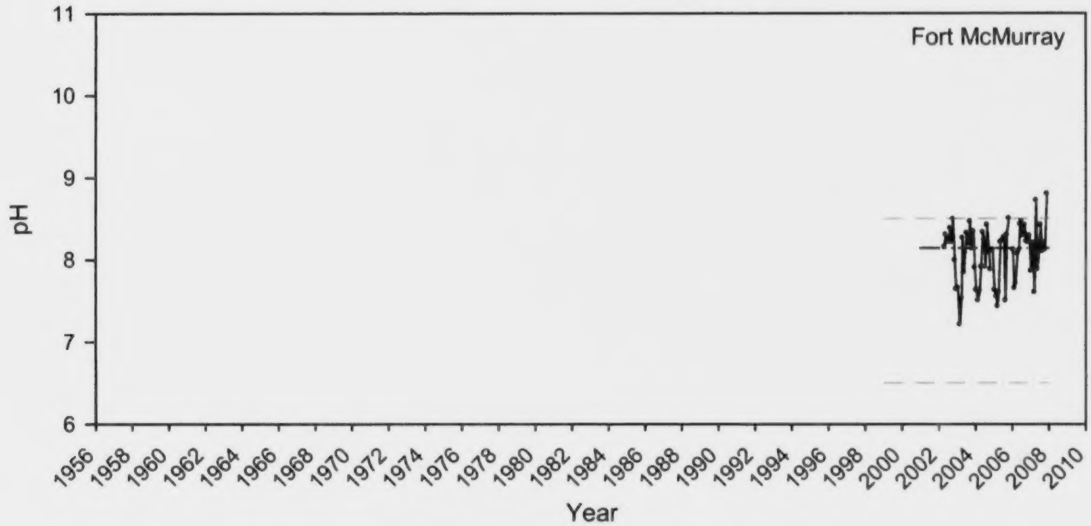


Figure 19 Seasonality of pH in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						8.03		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						8.14		
Flow Adjusted								

Figure 20 pH in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.

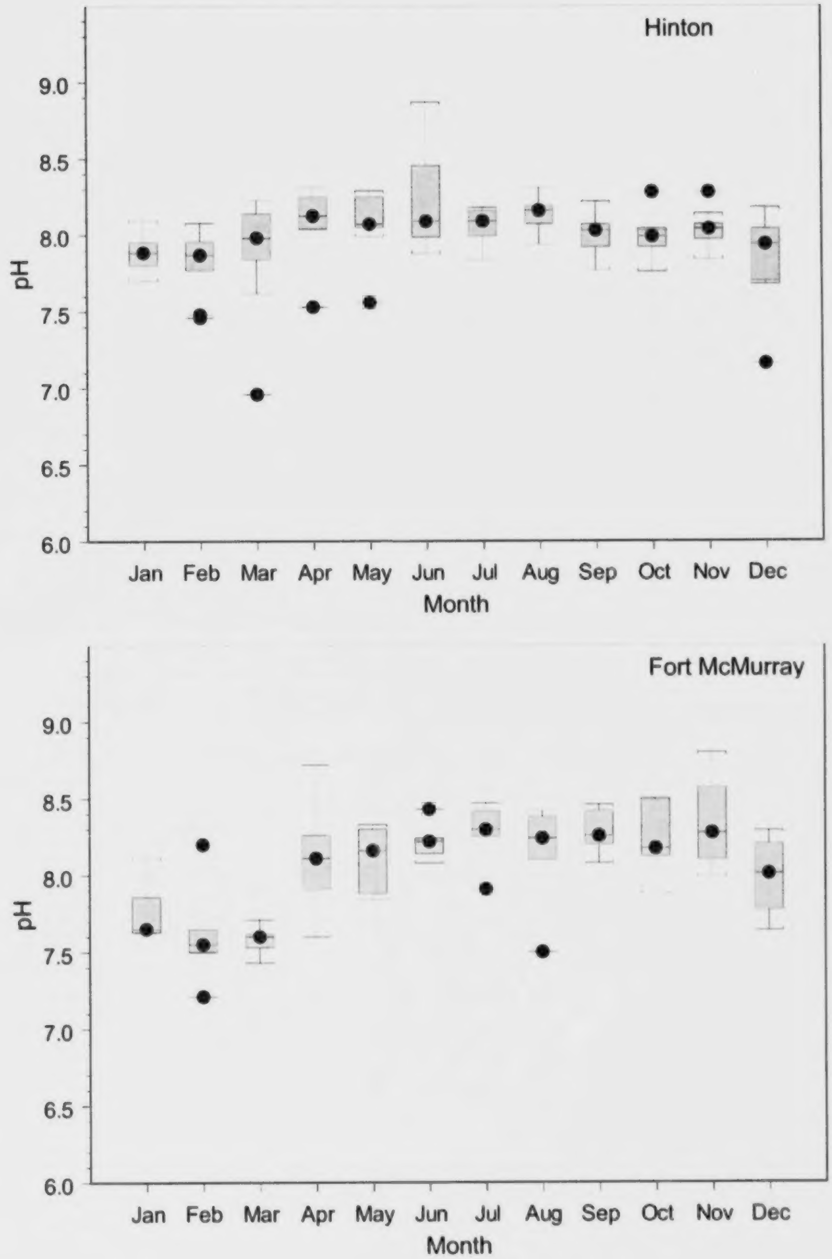
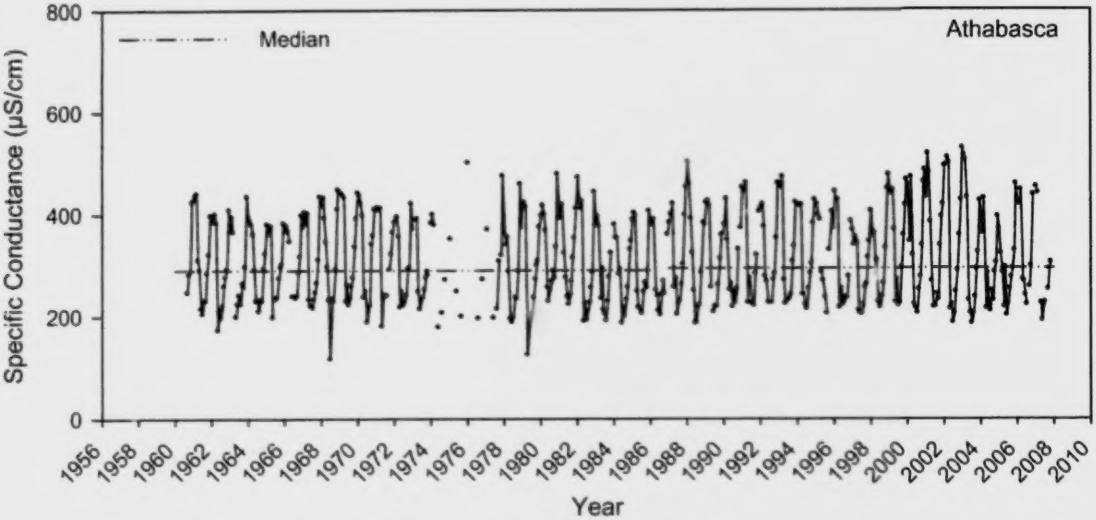
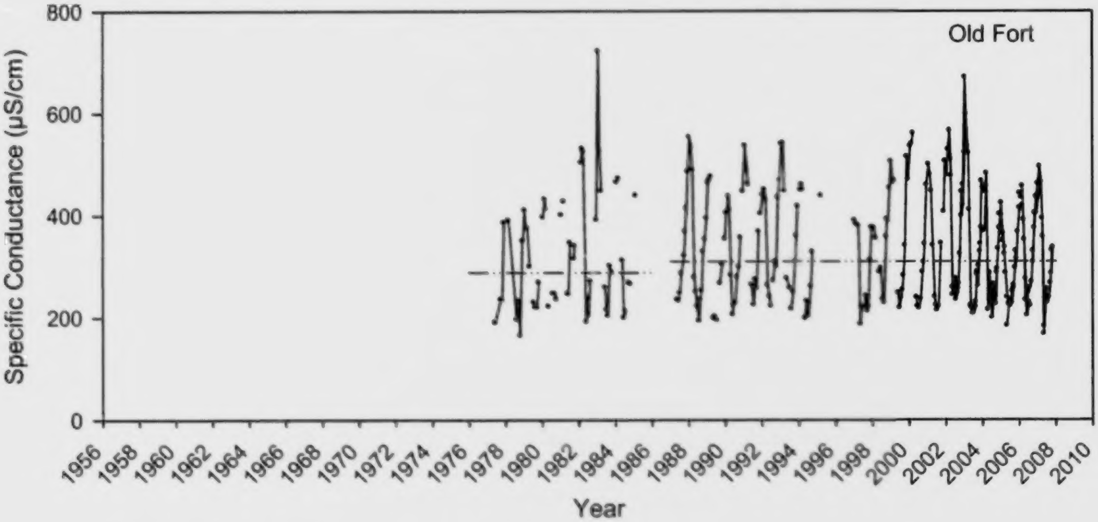


Figure 21 Seasonality of pH in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.3913	up	up	290.00	-0.1539	NS	294.00	0.2250	NS
Flow Adjusted								
0.2725	up			0.4222	NS		0.1459	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
-0.0526	NS	up	288.00	ID	ID	309.50	-0.9333	NS
Flow Adjusted								
-0.8551	down			ID	ID		-1.2447	down

Figure 22 Specific conductance in the Athabasca River at Athabasca and Old Fort. Significance of identified trends is at a 95% or better confidence interval. ID = Insufficient Data, NS = Not Significant.

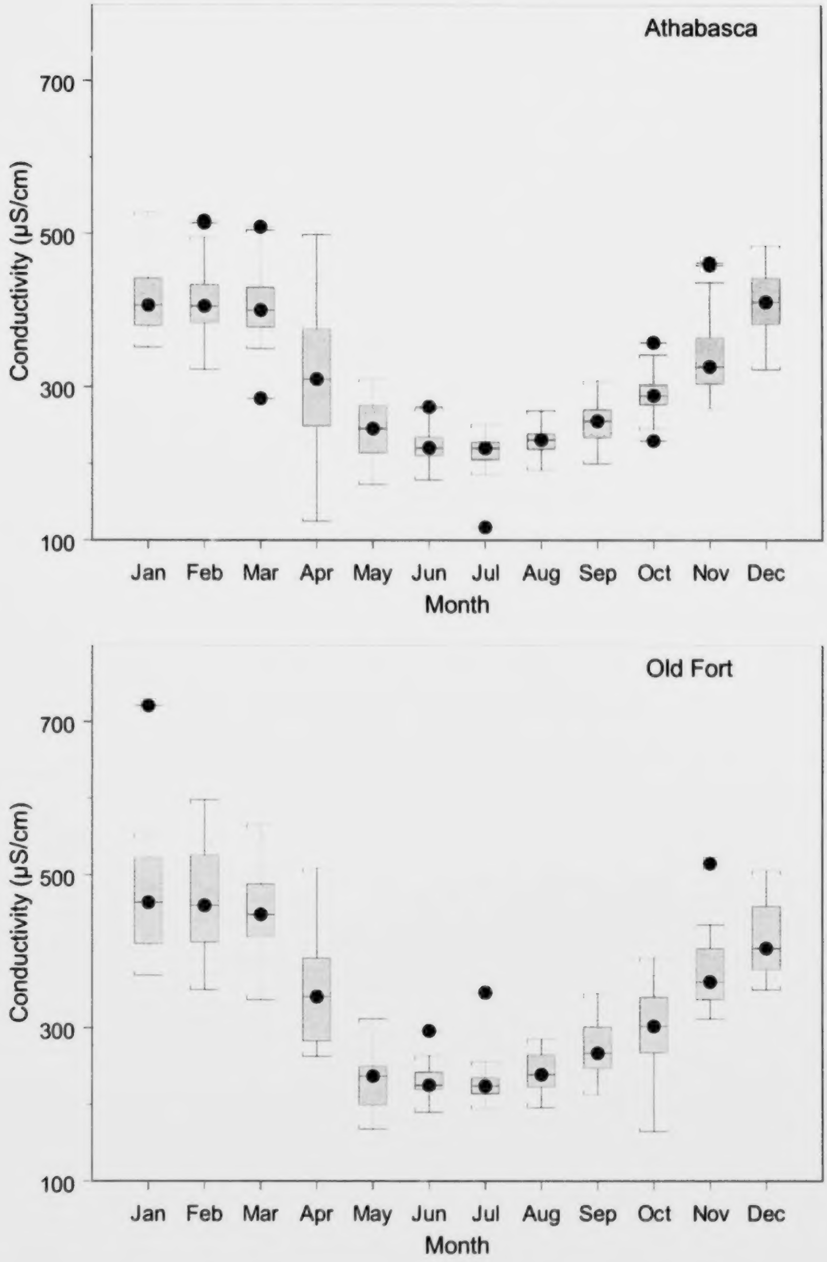
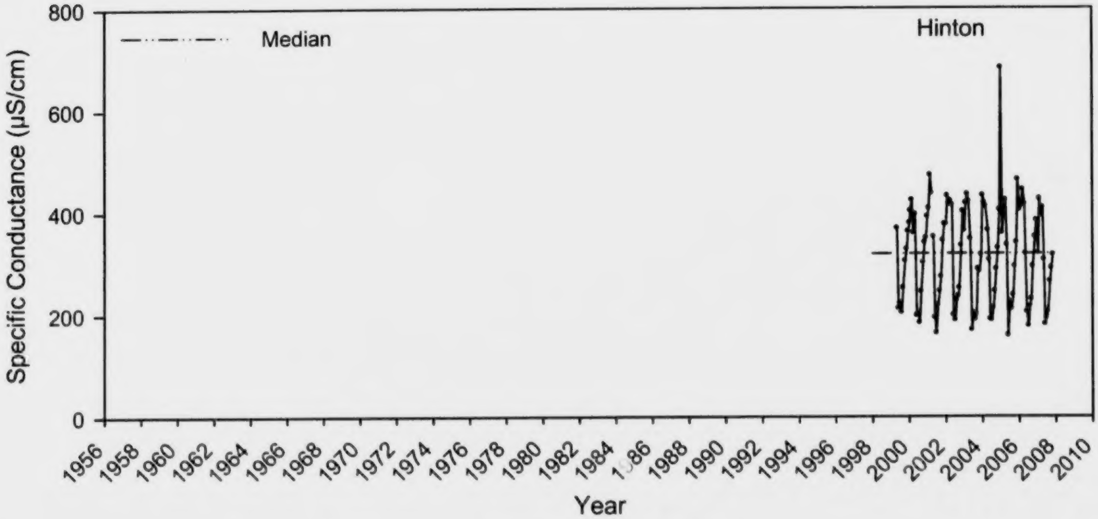
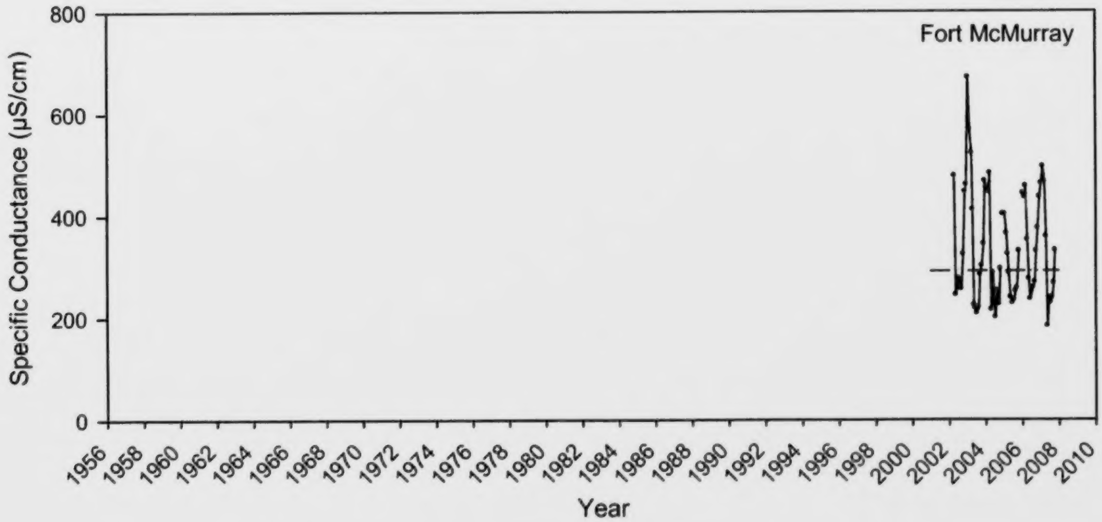


Figure 23 Seasonality of specific conductance in the Athabasca River at Athabasca and Old Fort.

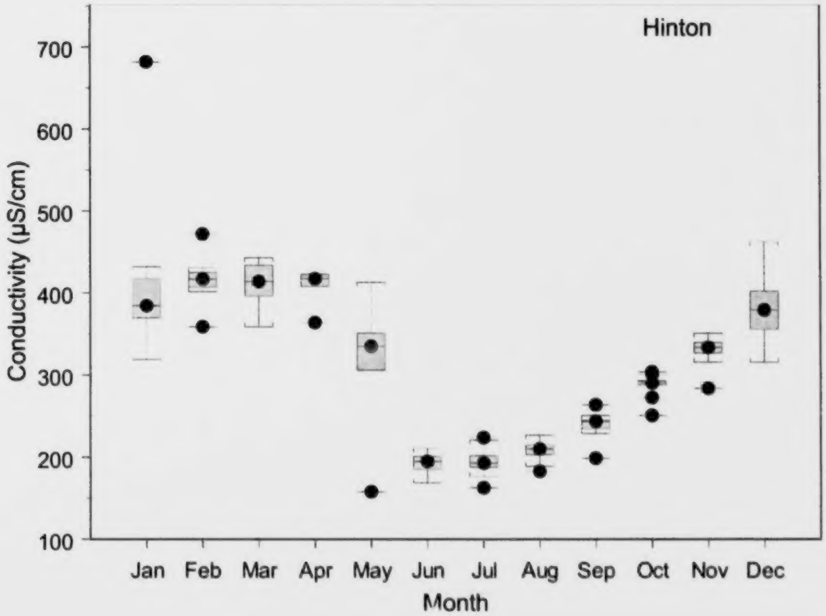


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						318.50		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						291.00		
Flow Adjusted								

Figure 24 Specific conductance in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.



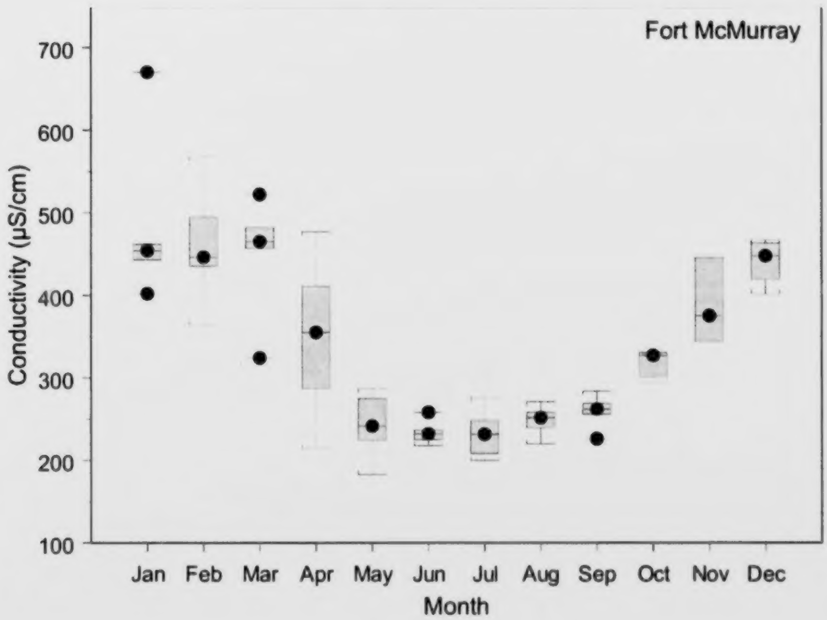
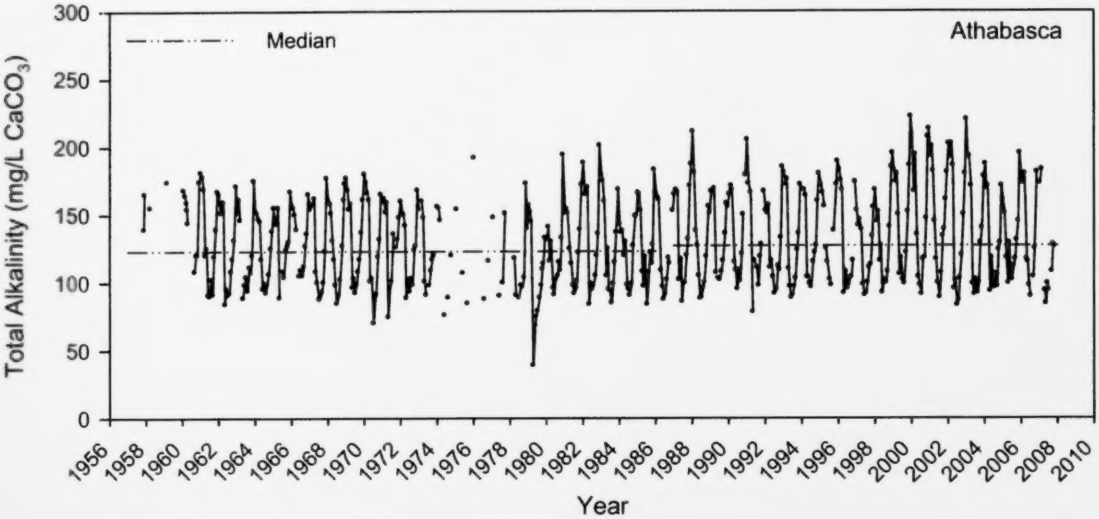
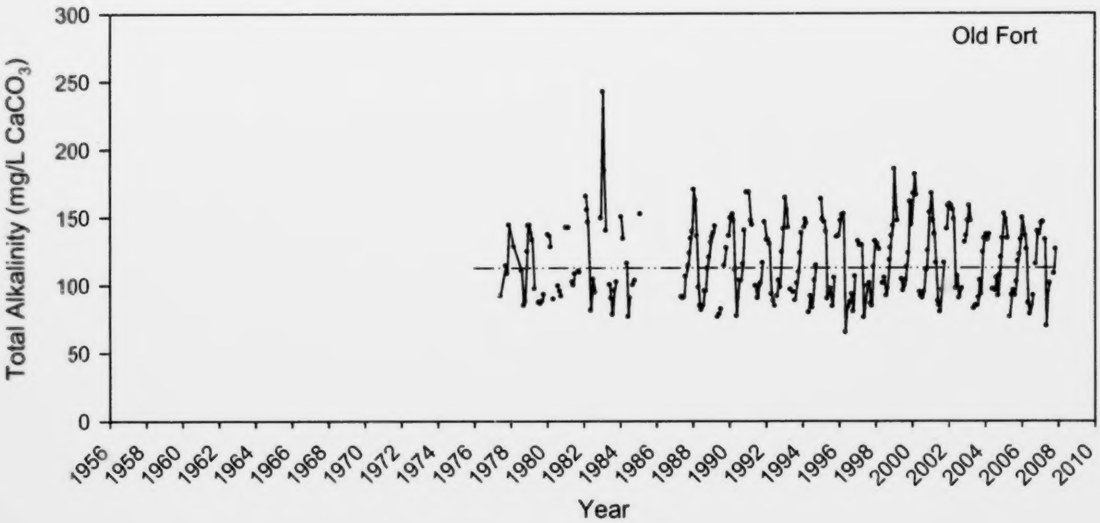


Figure 25 Seasonality of specific conductance in the Athabasca River at Hinton and Fort McMurray. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.2857	up	up	123.00	0.0000	NS	127.0	0.2143	NS
Flow Adjusted								
0.2405	up			0.2620	NS		0.1470	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0000	NS	NS	108.00	ID	ID	113.5	0.0000	NS
Flow Adjusted								
-0.1270	NS			ID	ID		-0.0153	NS

Figure 26 Total alkalinity in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

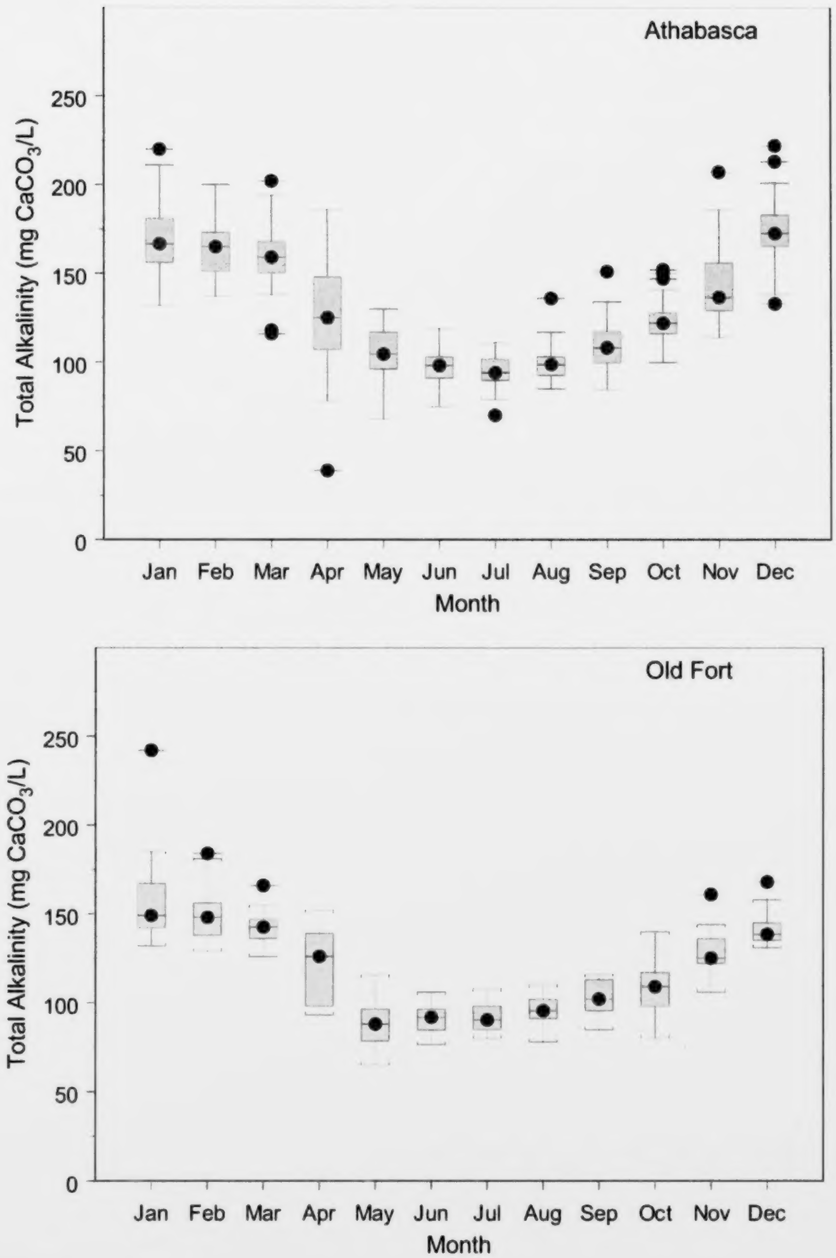
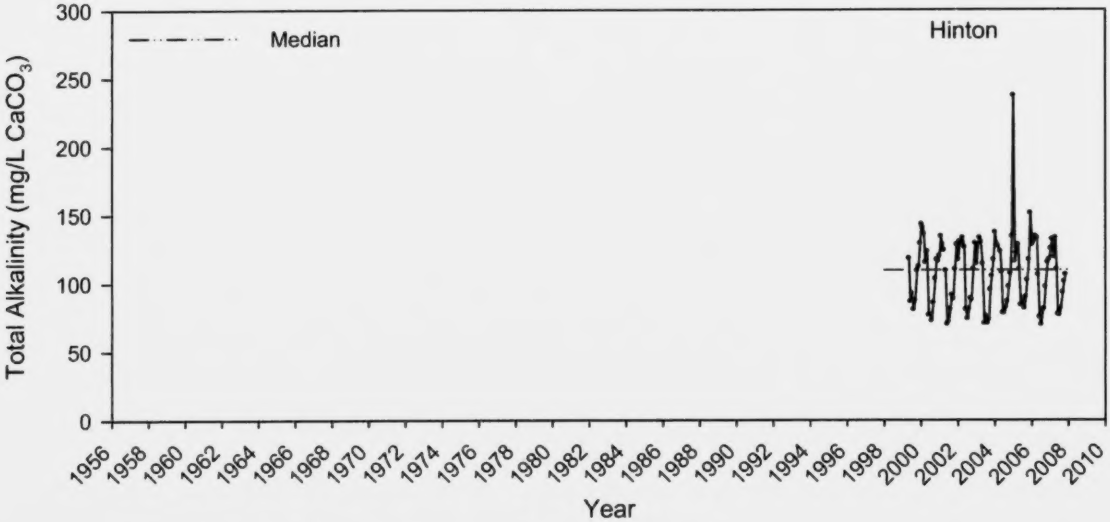
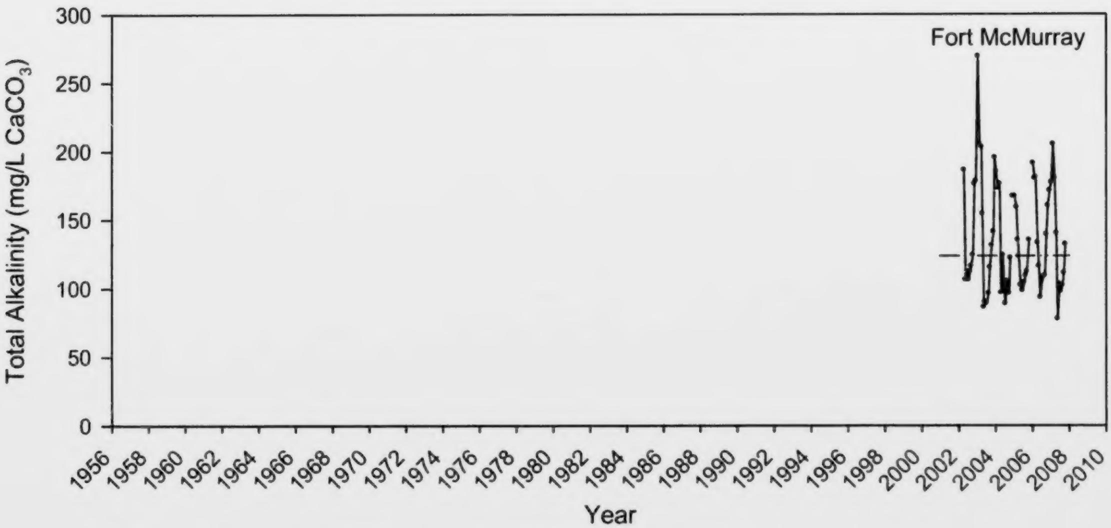


Figure 27 Seasonality of total alkalinity in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						109.50		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						123.50		
Flow Adjusted								

Figure 28 Total alkalinity in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.

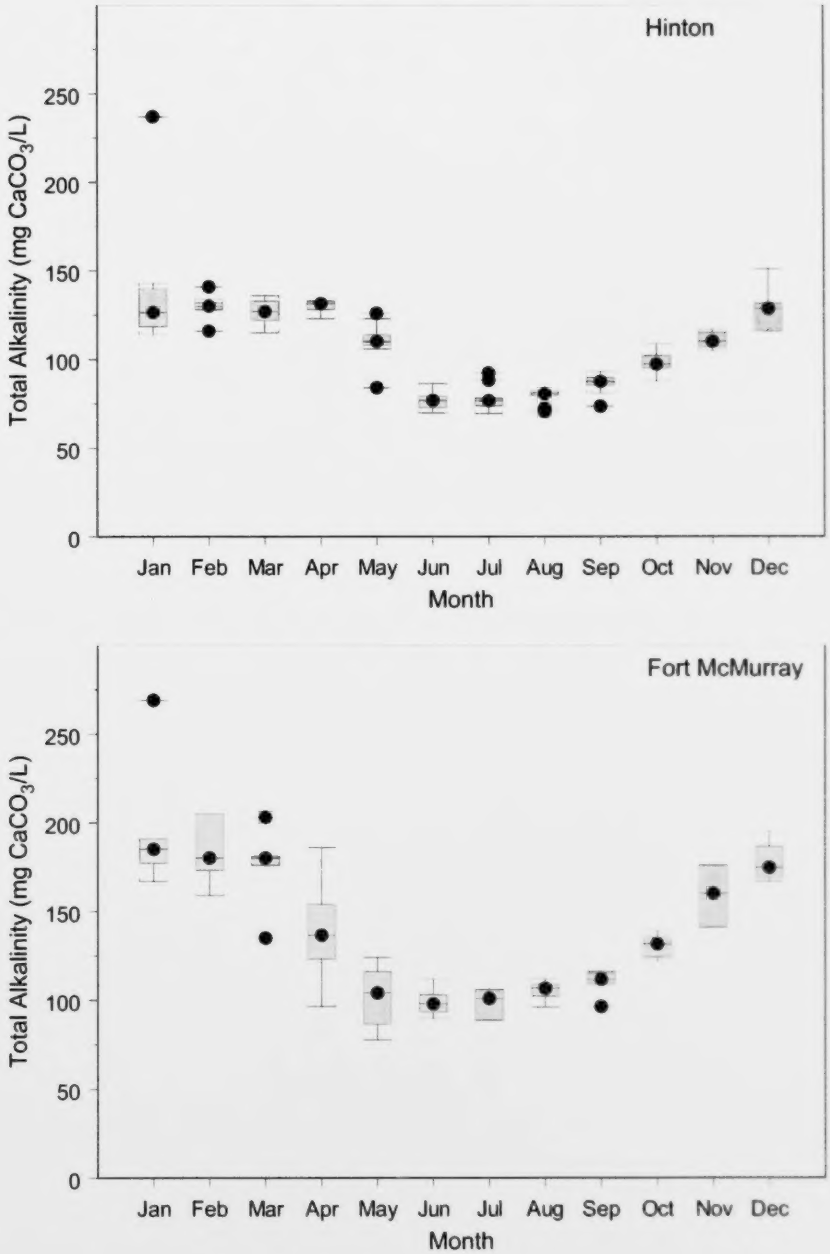
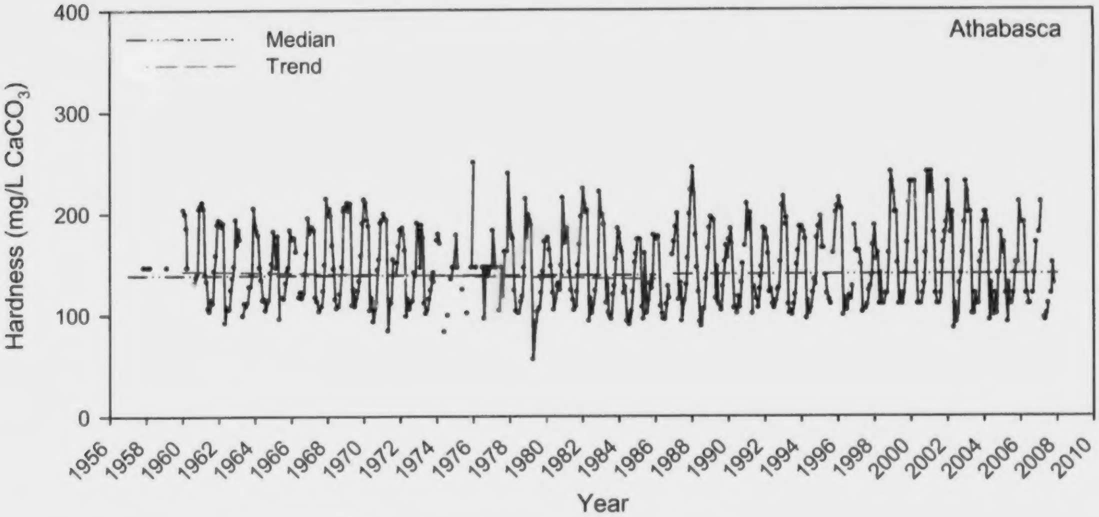
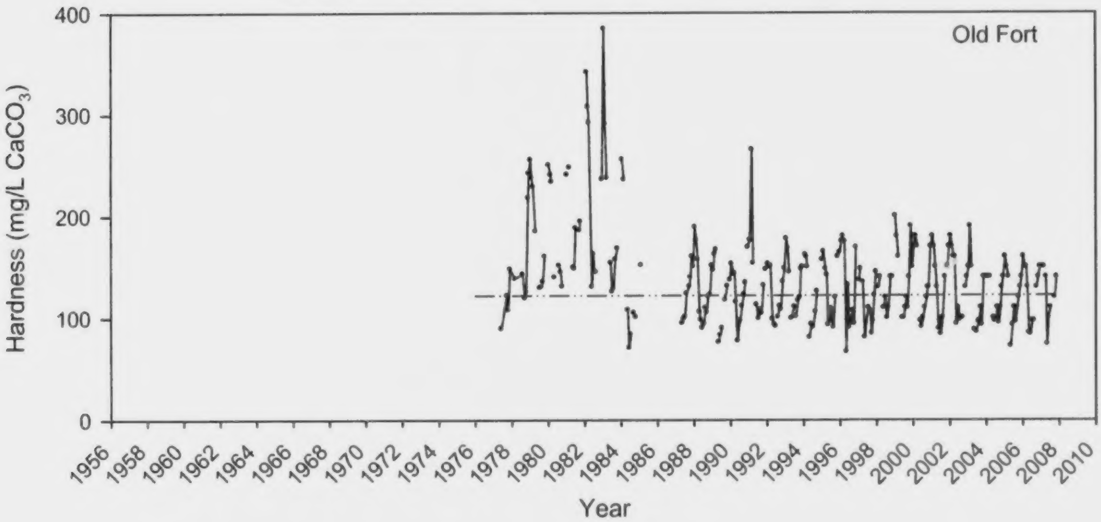


Figure 29 Seasonality of total alkalinity in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0847	NS	up	138.85	-0.3140	down	140.00	0.1308	NS
Flow Adjusted								
-0.0073	NS			0.2620	NS		0.0885	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
-0.0308	NS	NS	113.41	ID	ID	122.81	-0.0971	NS
Flow Adjusted								
-0.2880	down			ID	ID		-0.2914	NS

Figure 30 Hardness of Athabasca River water at Athabasca and Old Fort. Some pre-1987 values were calculated, based on calcium and magnesium concentrations. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

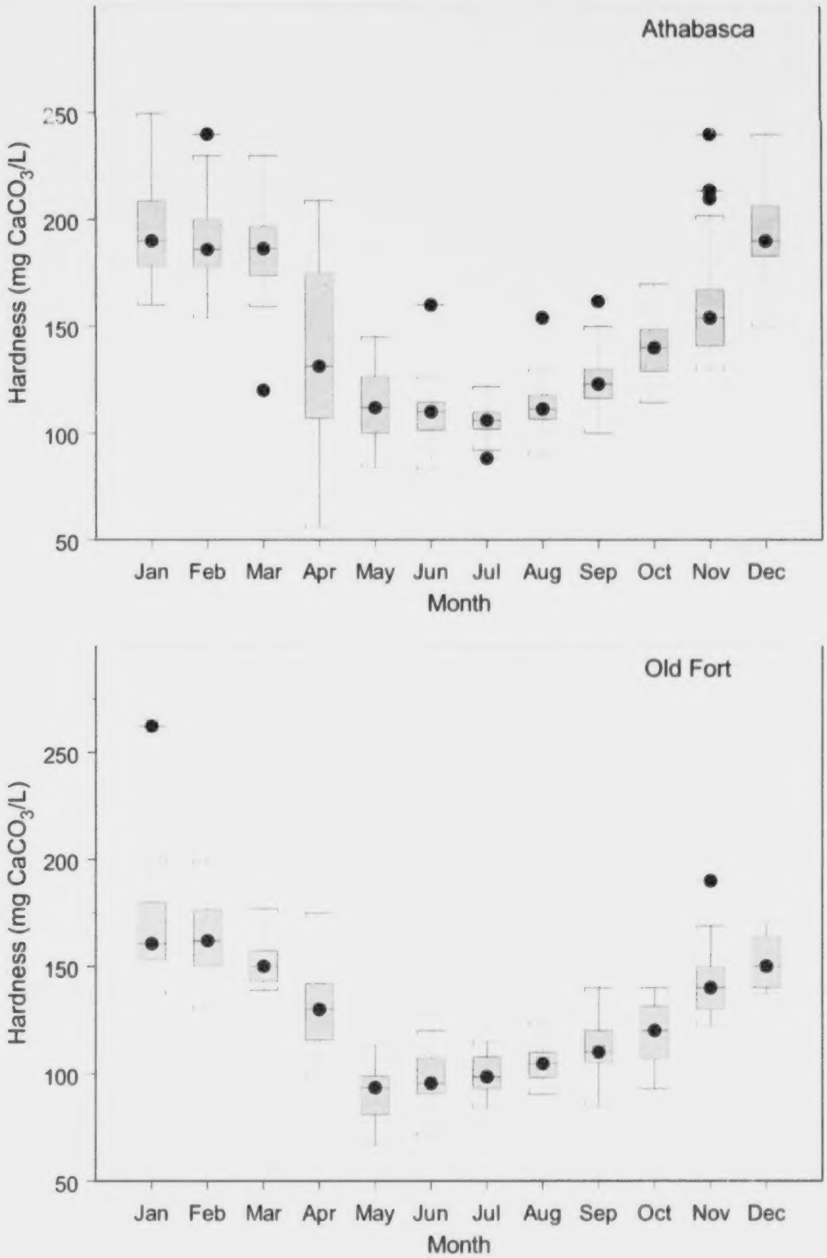
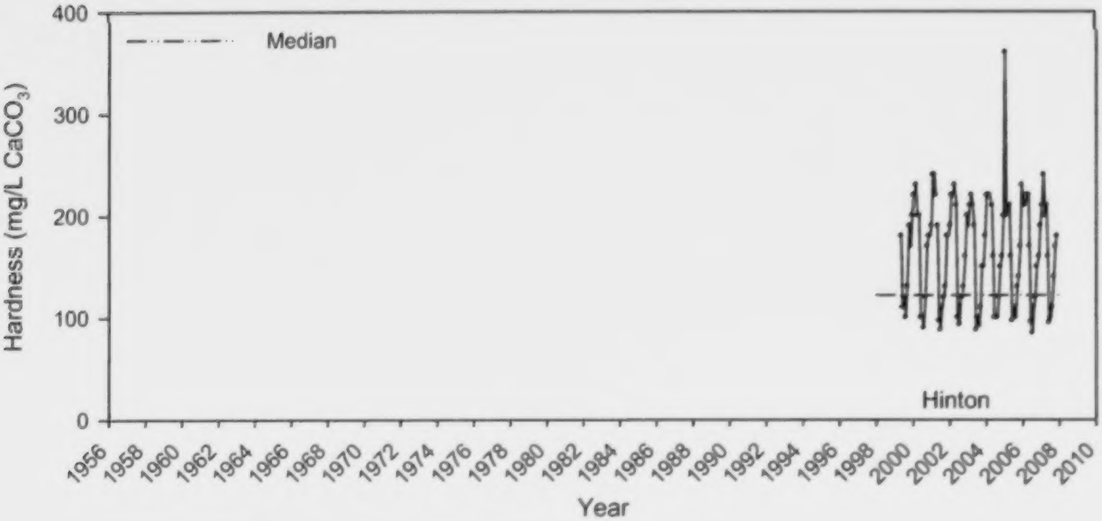
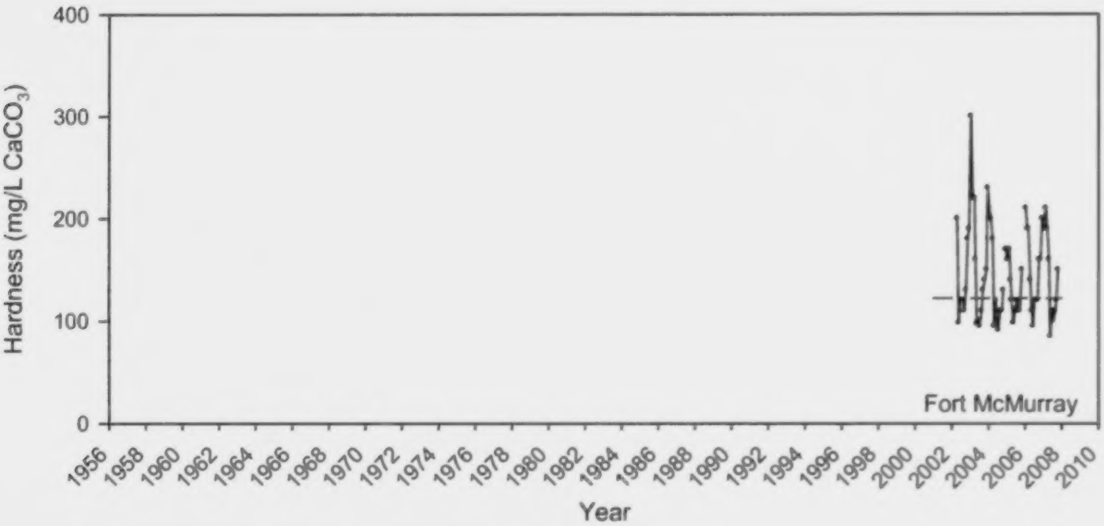


Figure 31 Seasonality of hardness in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						170.00		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						130.00		
Flow Adjusted								

Figure 32 Hardness of Athabasca River water at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.

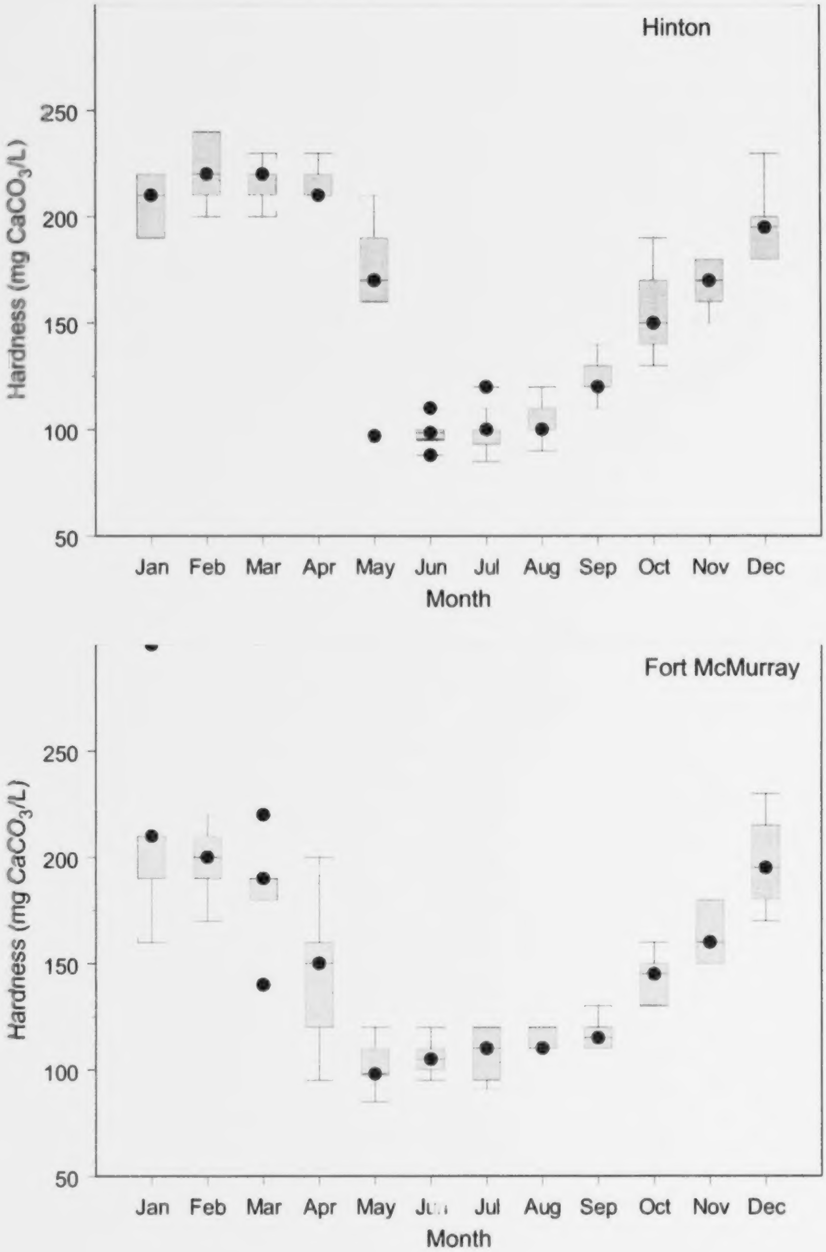
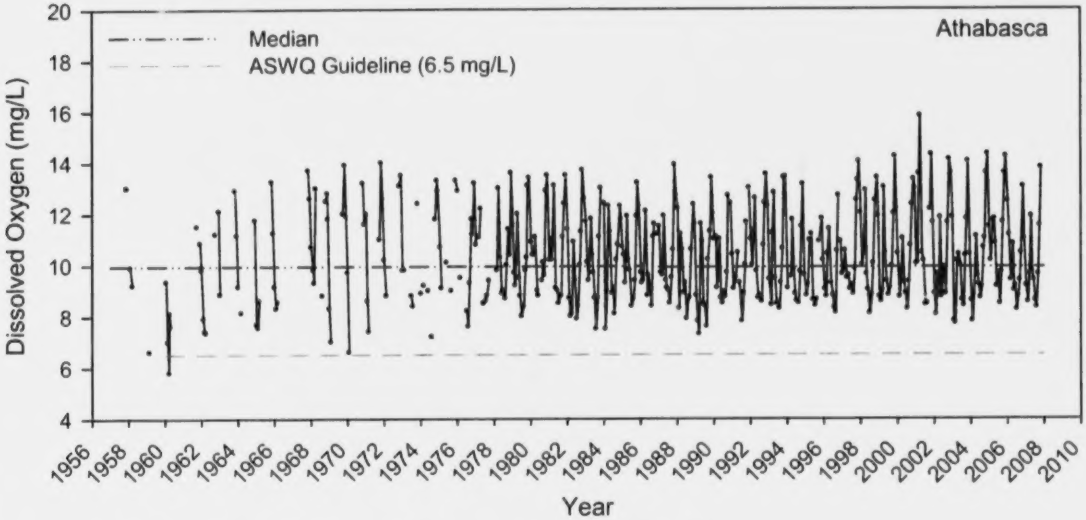
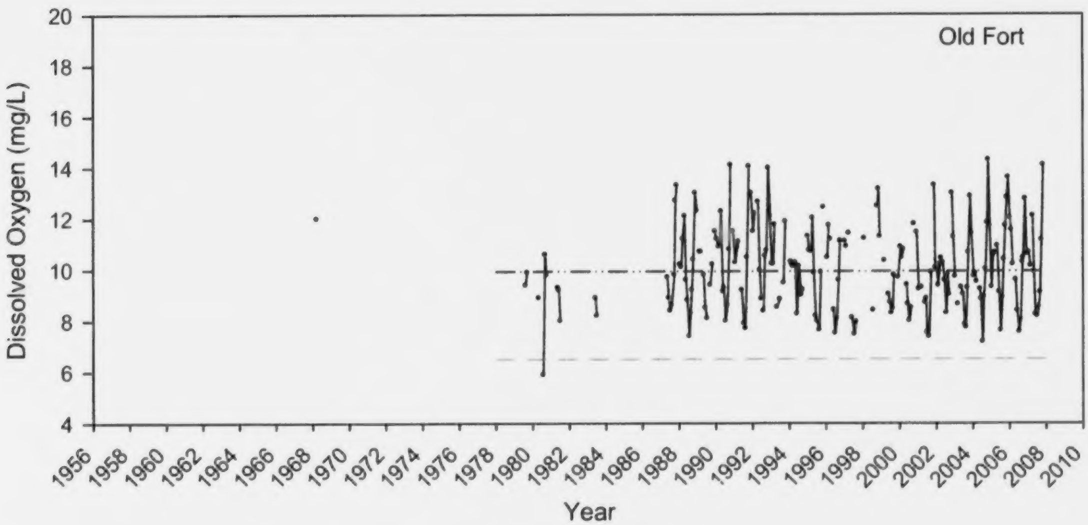


Figure 33 Seasonality of hardness in the Athabasca River at Hinton and Fort McMurray.

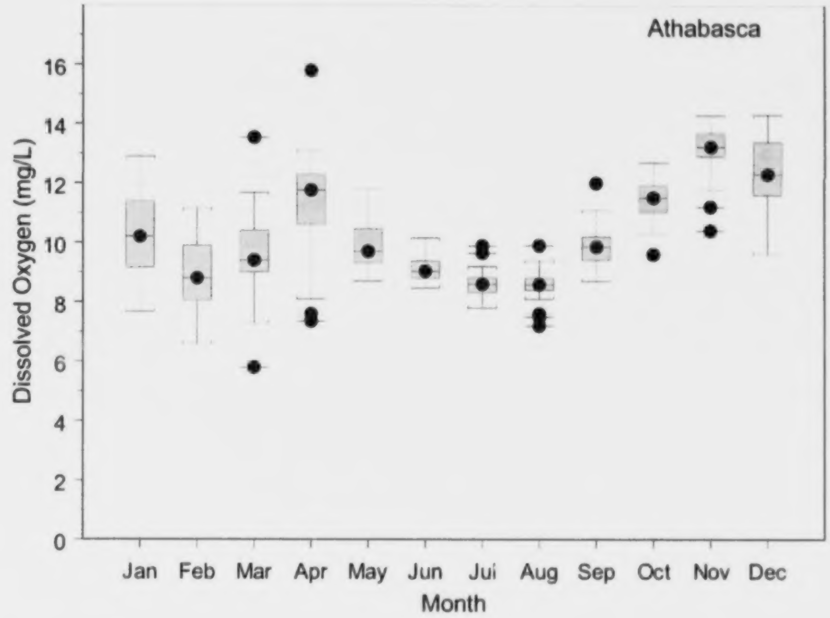


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0078	NS	up	9.95	0.0000	NS	9.92	0.0152	NS
Flow Adjusted								
0.0048	NS			0.0005	NS		0.0123	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	ID	9.20	ID	ID	10.08	-0.0447	NS
Flow Adjusted								
ID	ID			ID	ID		-0.0729	NS

Figure 34 Dissolved oxygen concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.



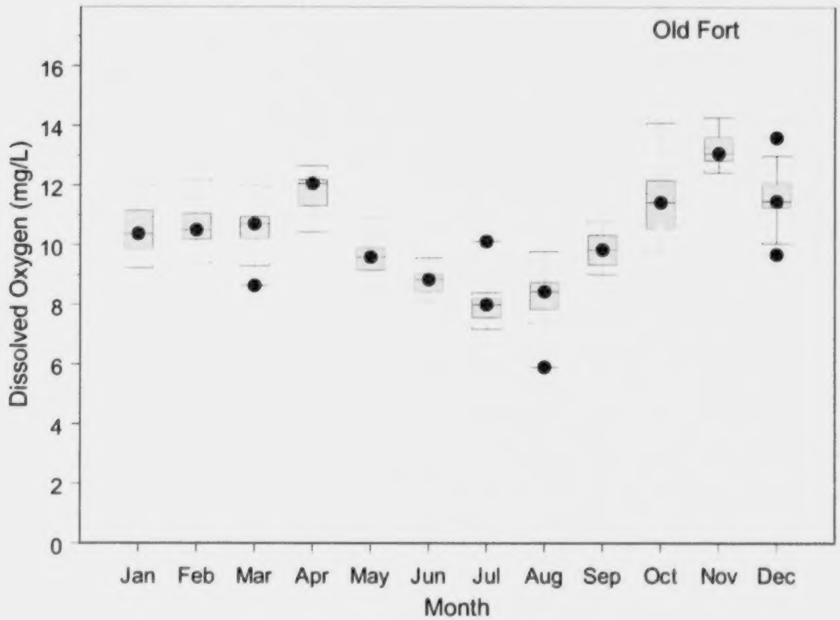
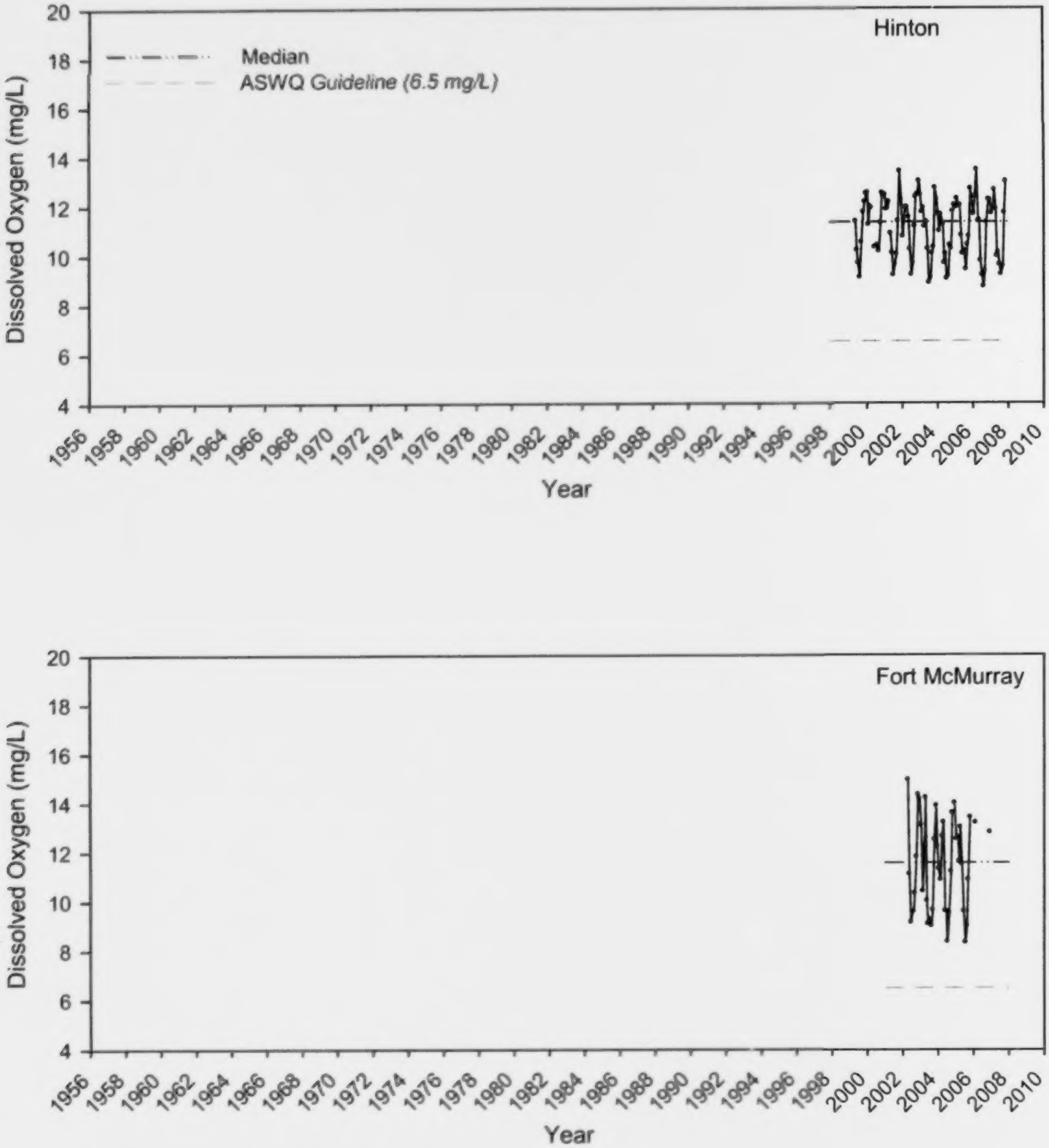


Figure 35 Seasonality of dissolved Oxygen concentration in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						11.57		
Flow Adjusted								

Figure 36 Dissolved oxygen concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.

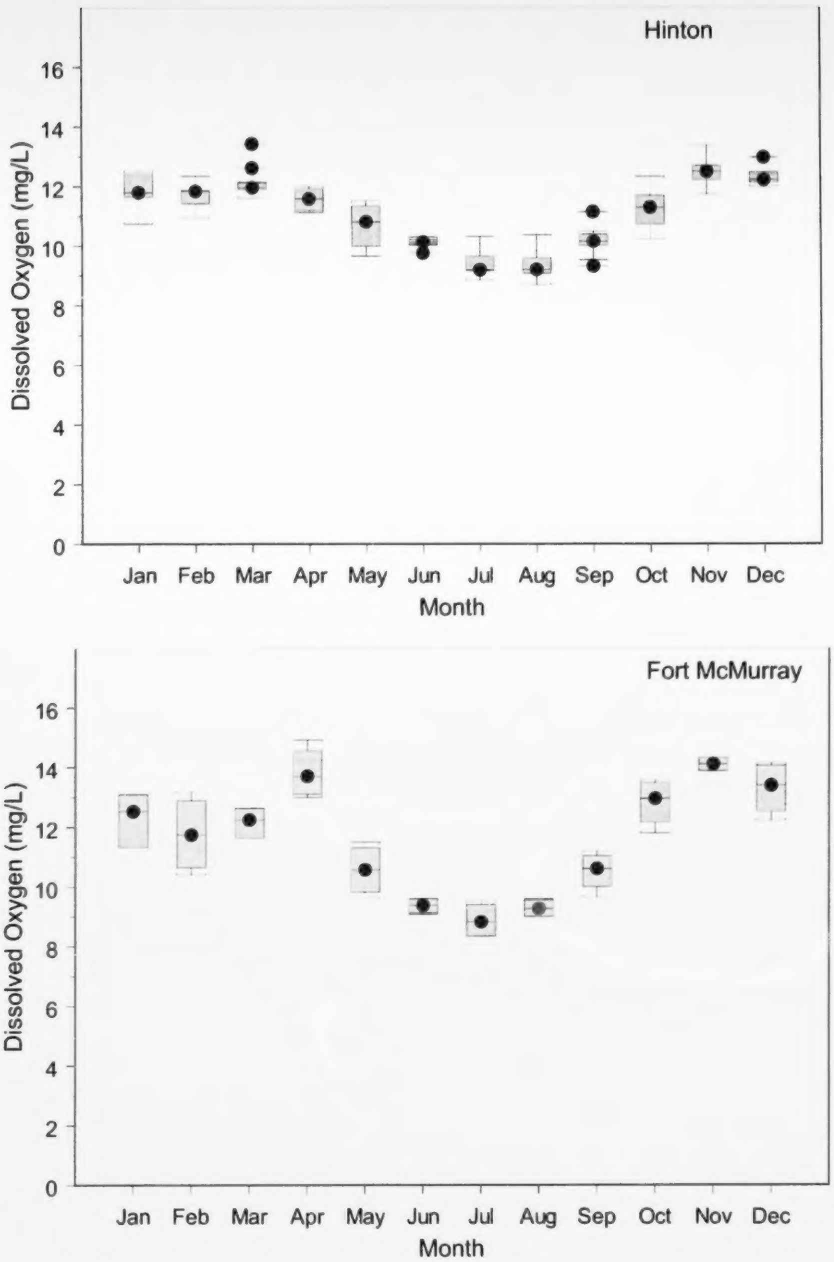
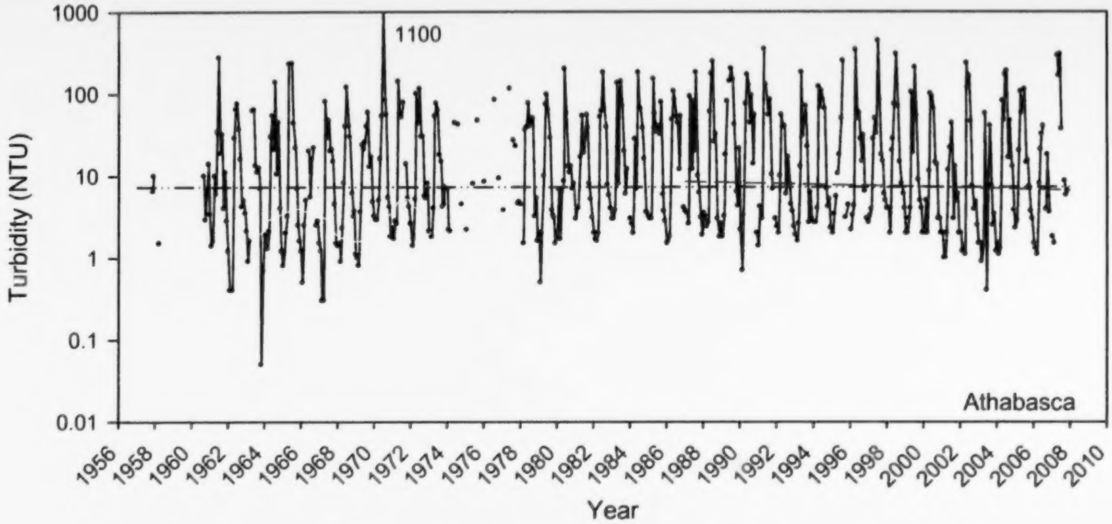
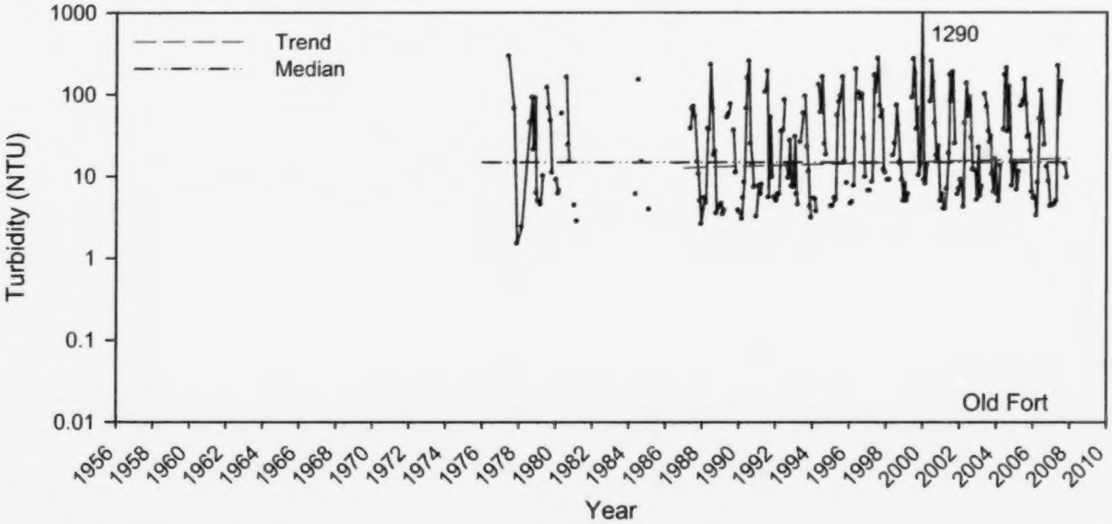


Figure 37 Seasonality of dissolved oxygen concentration in the Athabasca River at Hinton and Fort McMurray.

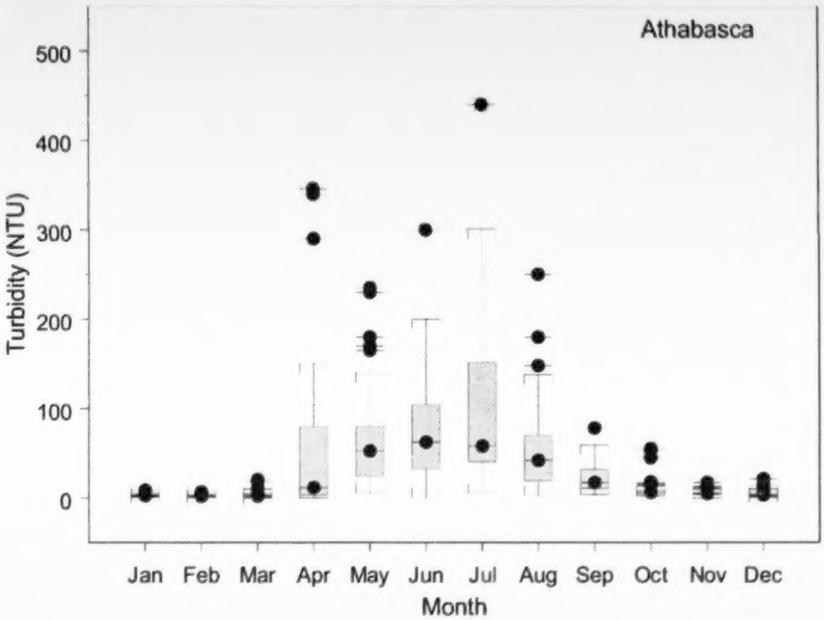


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0126	NS	NS	7.00	0.1106	up	7.40	-0.0875	down
Flow Adjusted								
0.0482	up			0.0801	NS		-0.0900	down



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	ID	14.80	ID	ID	14.55	0.1750	up
Flow Adjusted								
ID	ID			ID	ID		0.2608	up

Figure 38 Turbidity of Athabasca River water at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.



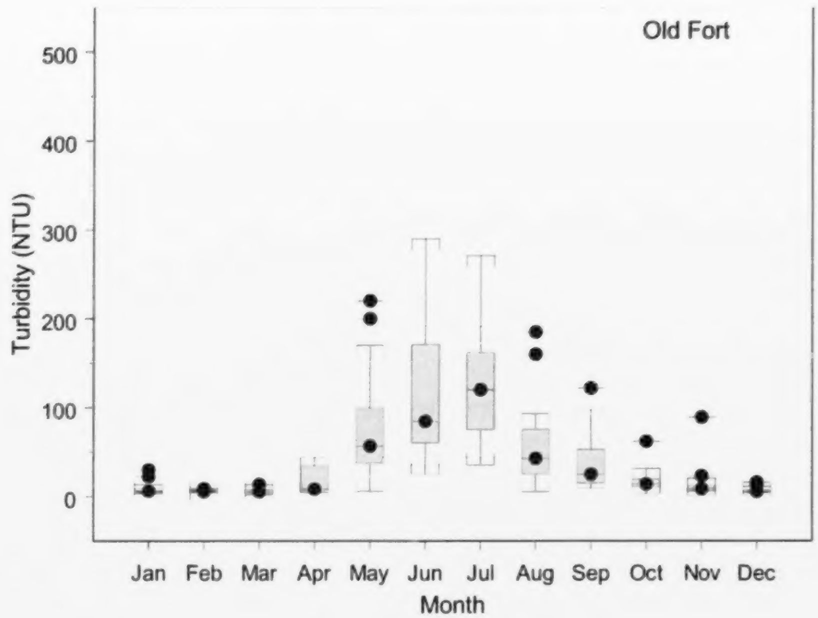
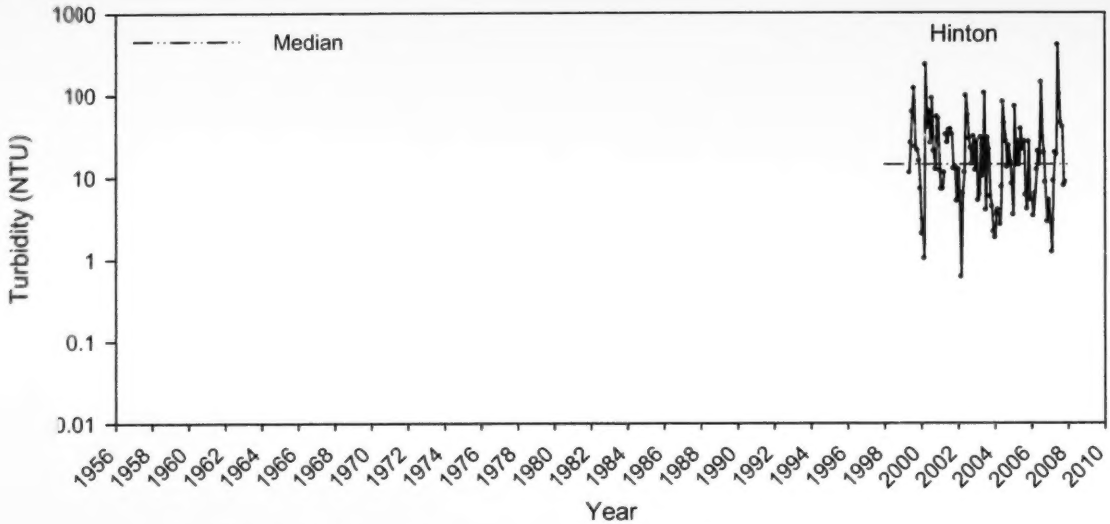
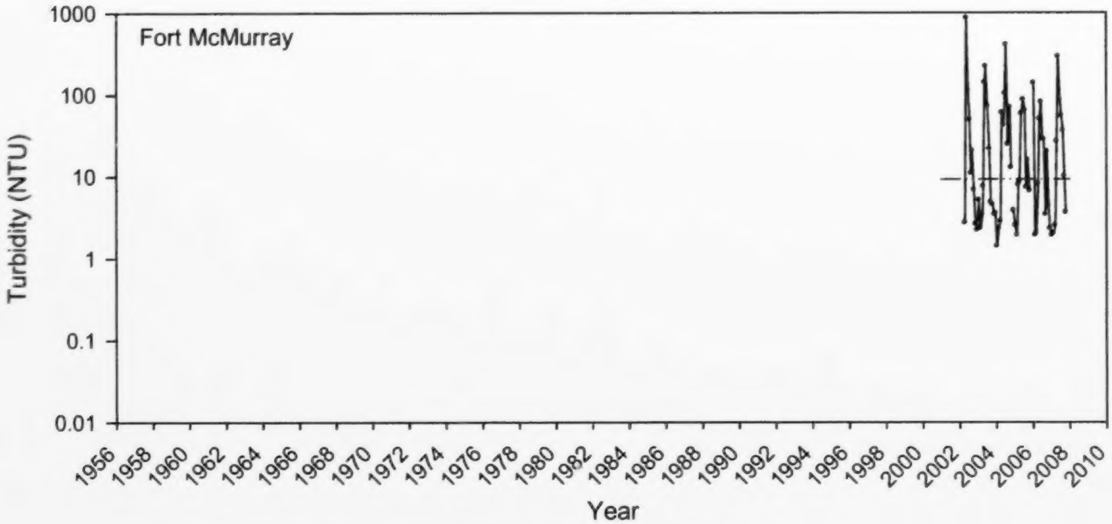


Figure 39 Seasonality of turbidity in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						14.10		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						9.20		
Flow Adjusted								

Figure 40 Turbidity of Athabasca River water at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.

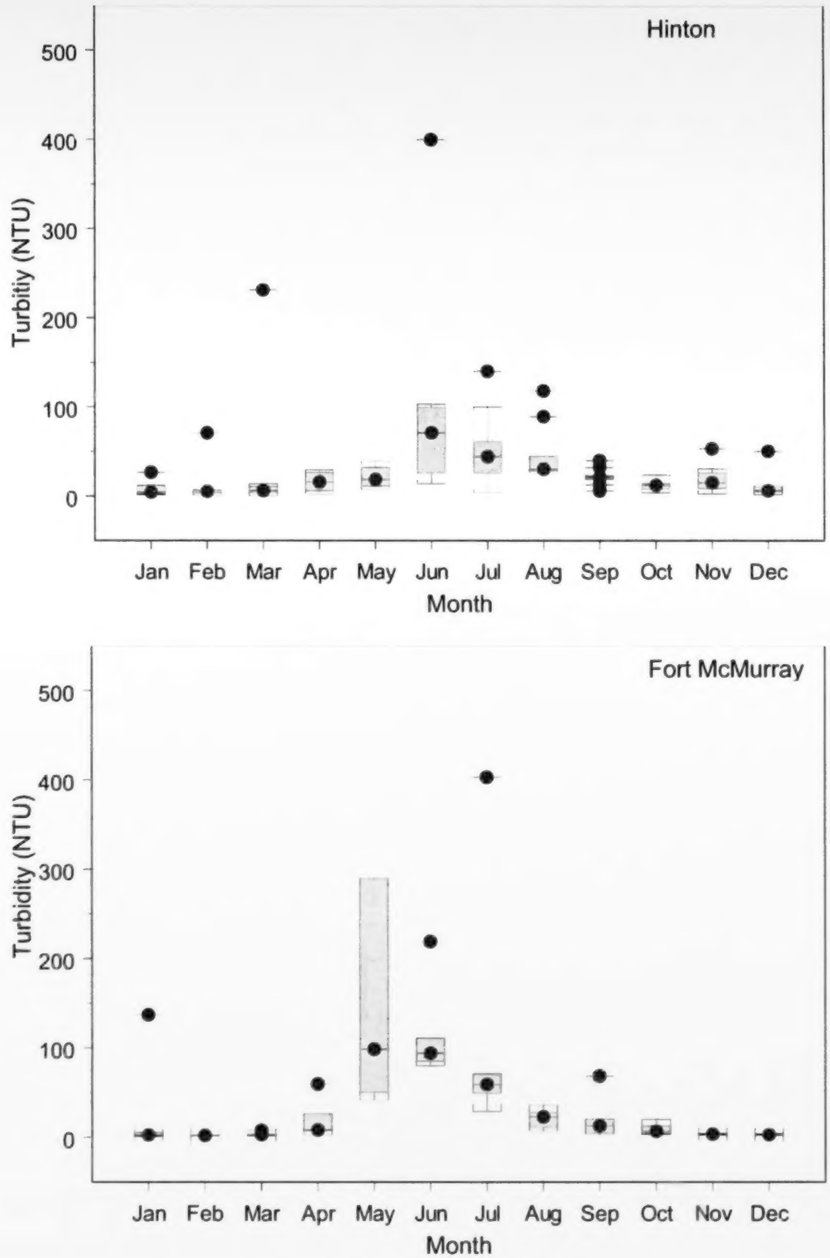
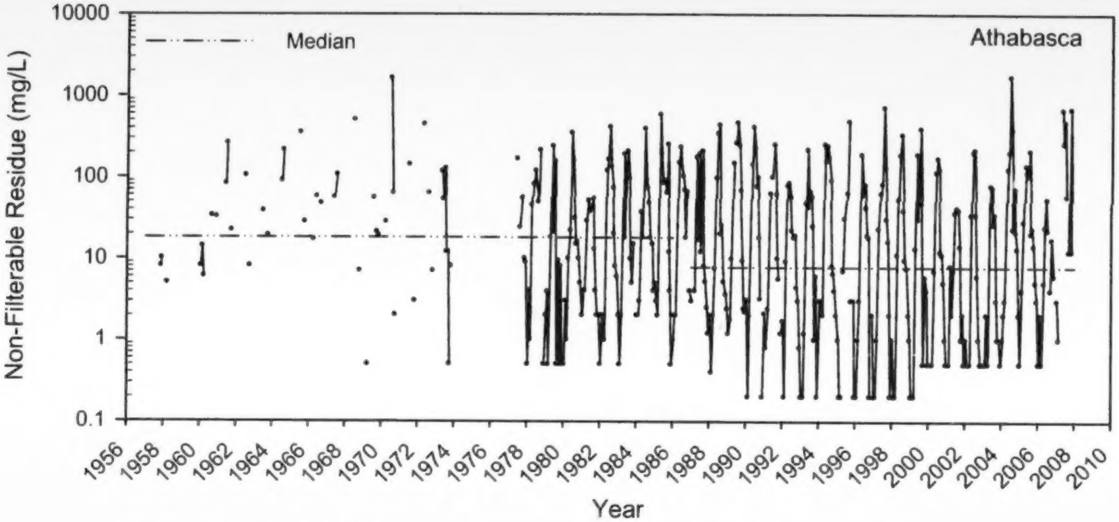
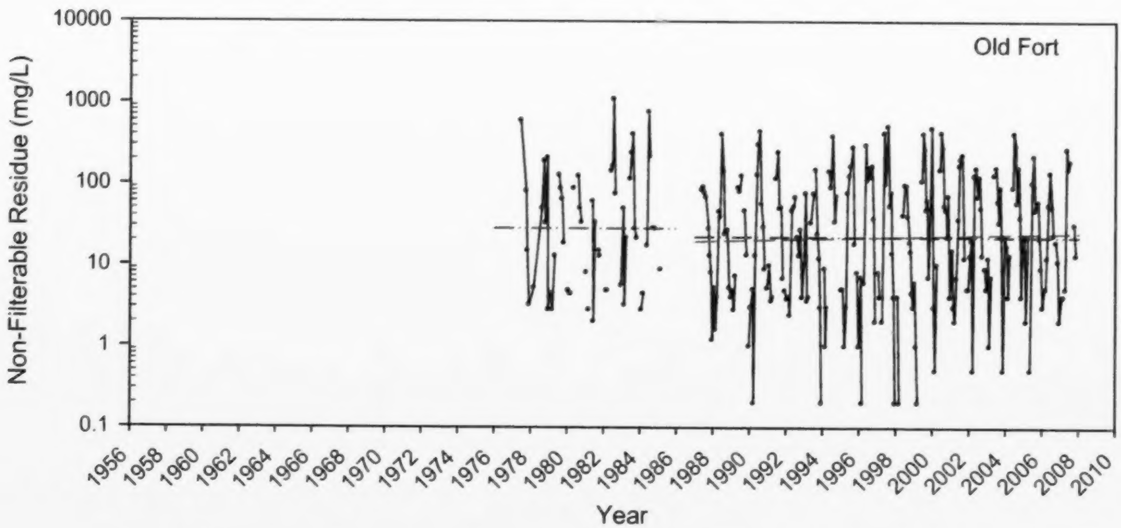


Figure 41 Seasonality of turbidity in the Athabasca River at Hinton and Fort McMurray.

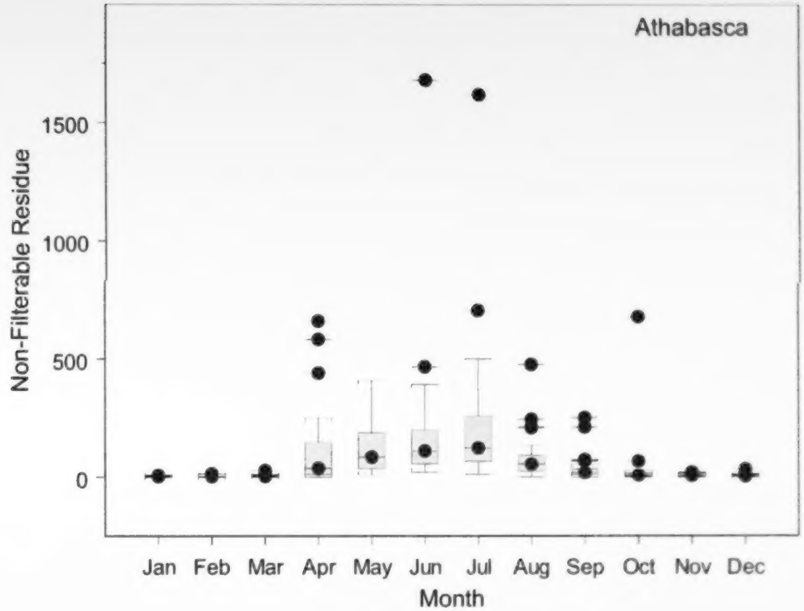


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
-0.3163%	NS	down	18.00	6.5582%	up	7.80	-0.8677%	NS
Flow Adjusted								
0.0080	NS			0.1500	NS		-0.0493	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0296	NS	down	28.00	ID	ID	22.00	0.2500	up
Flow Adjusted								
0.0296	up			ID	ID		0.3679	up

Figure 42 Non-filterable residue in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., p<0.05). ID = Insufficient Data, NS = Not Significant.



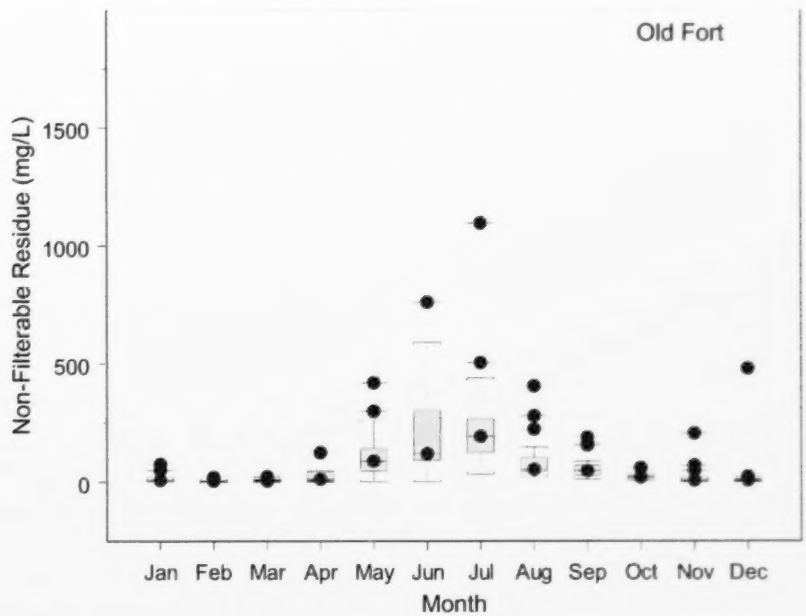
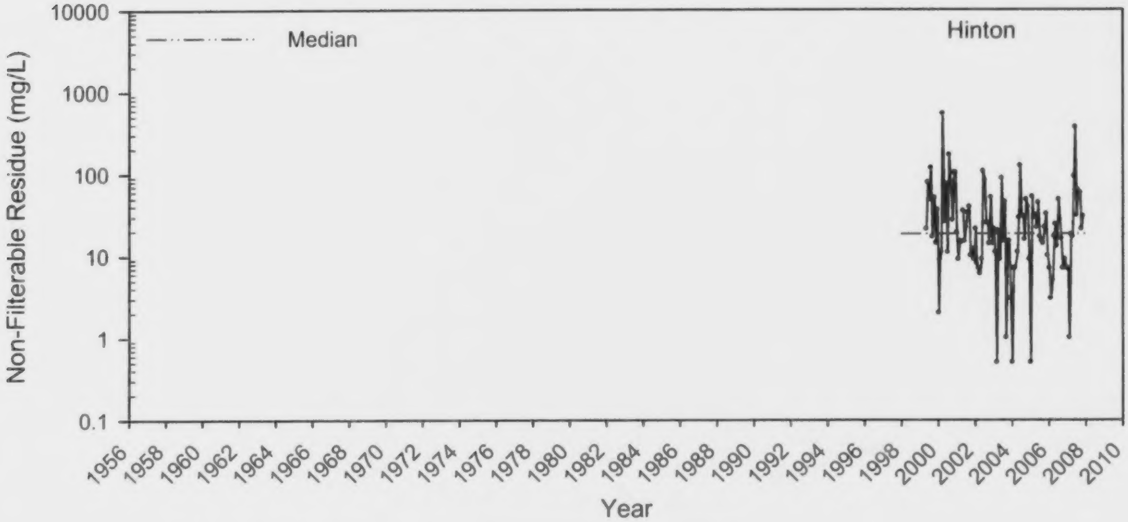
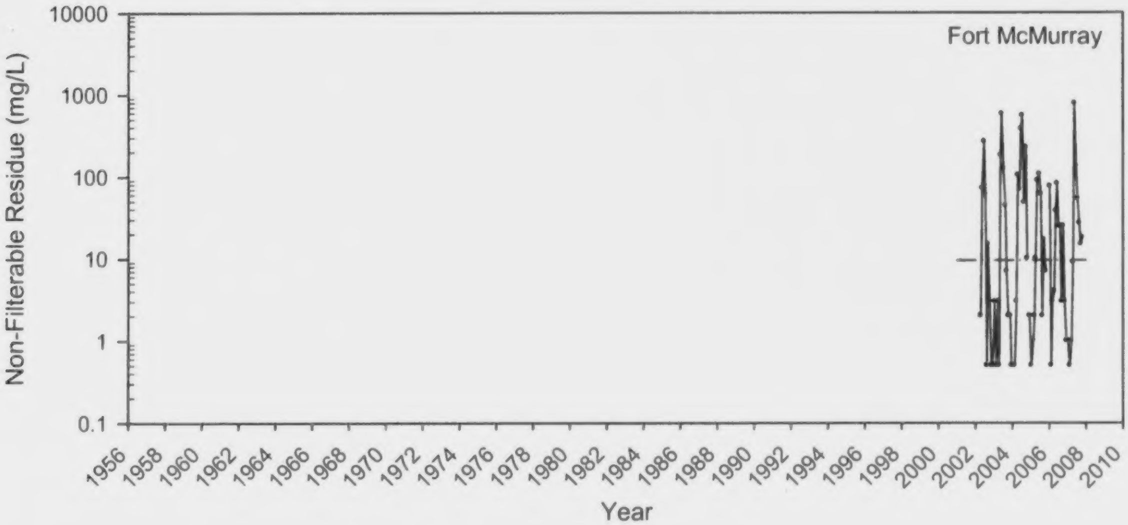


Figure 43 Seasonality of non-filterable residue in the Athabasca River at Athabasca and Old Fort.

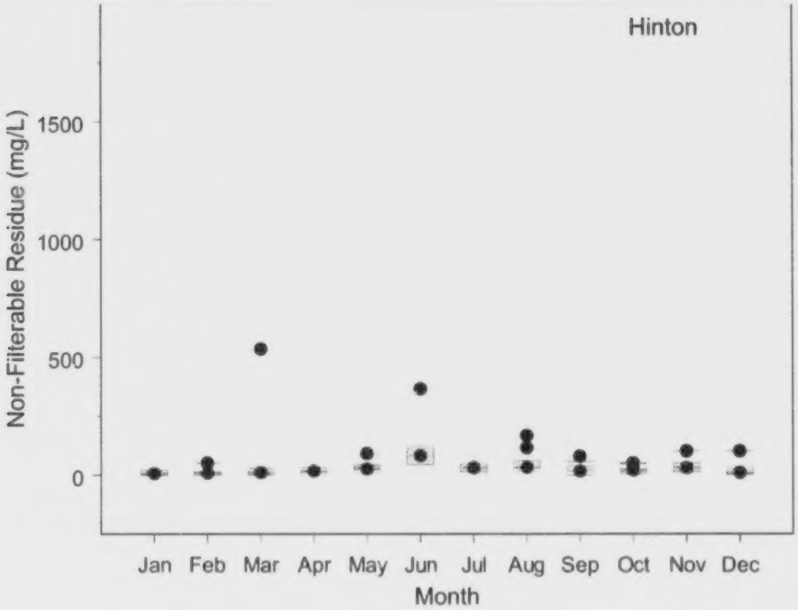


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						18.50		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						9.50		
Flow Adjusted								

Figure 44 Non-filterable residue in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.



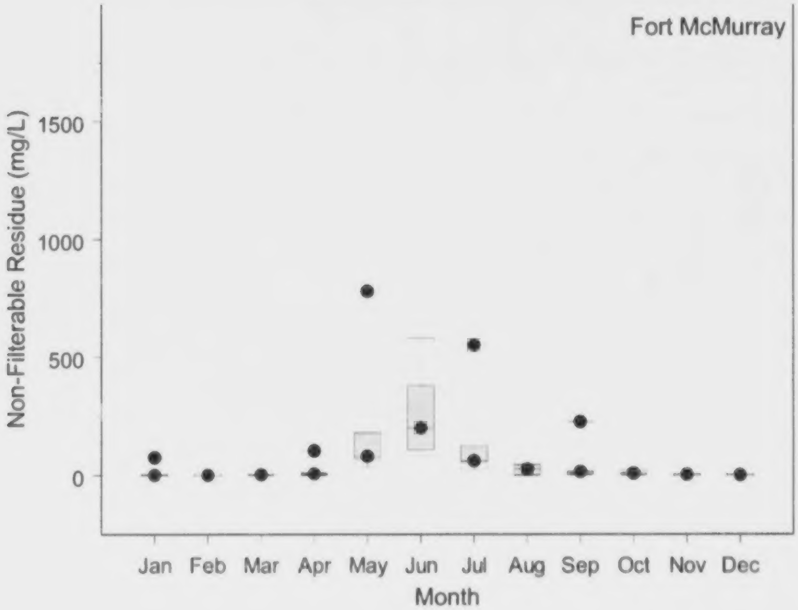
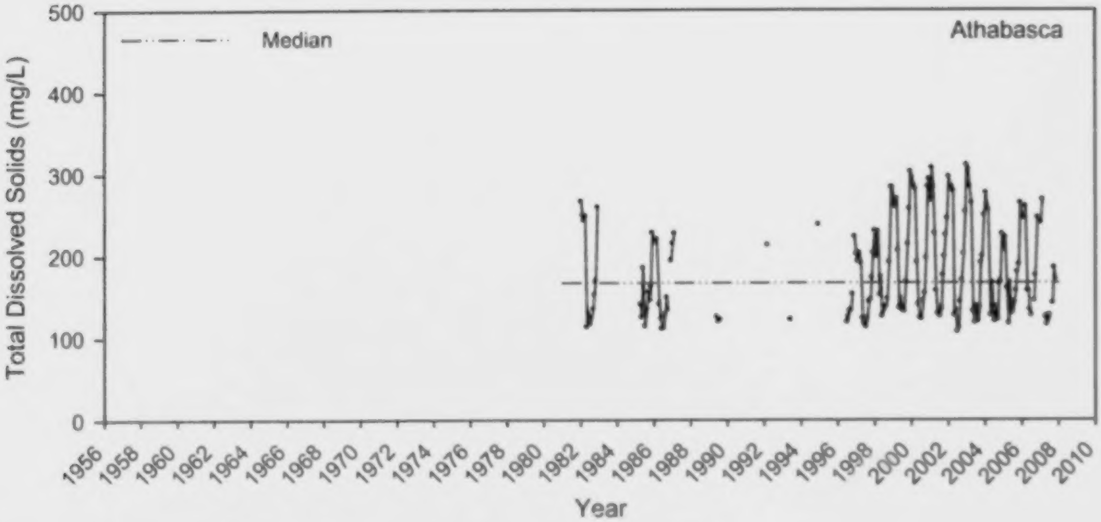
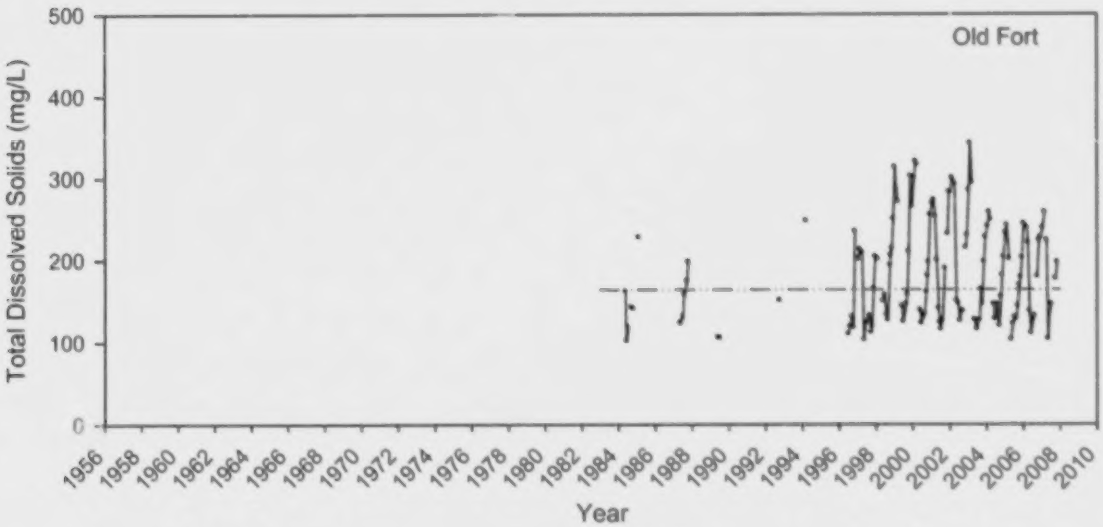


Figure 45 Seasonality of non-filterable residue in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	ID	147.50	ID	ID	170.50	-1.2857	NS
Flow Adjusted								
ID	ID			ID	ID		0.1711	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	ID	141.85	ID	ID	169.00	-2.2000	NS
Flow Adjusted								
ID	ID			ID	ID		-0.6686	NS

Figure 46 Total dissolved solids in the Athabasca River at Athabasca and Old Fort. ID= Insufficient Data, NS = Not Significant.

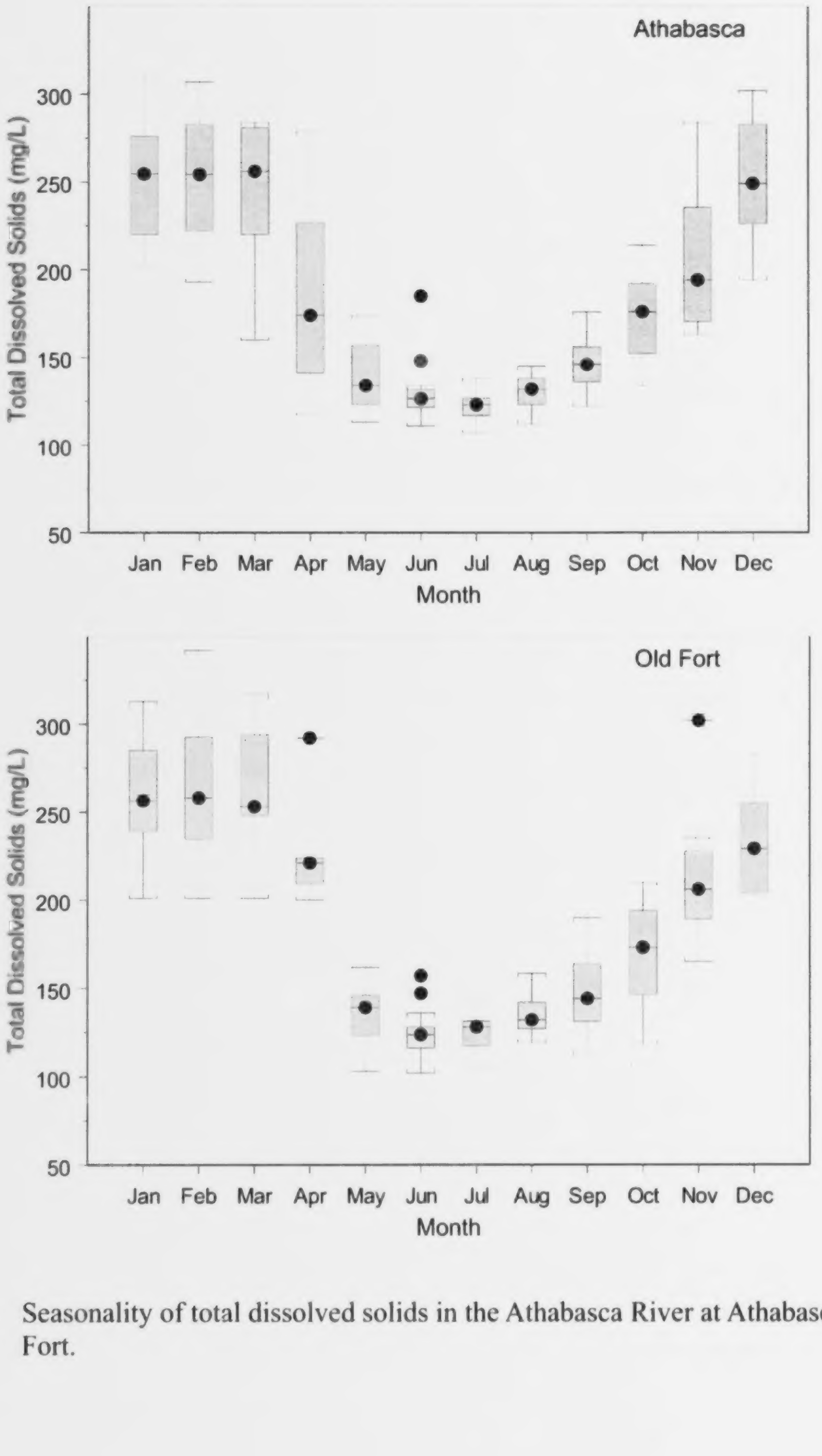
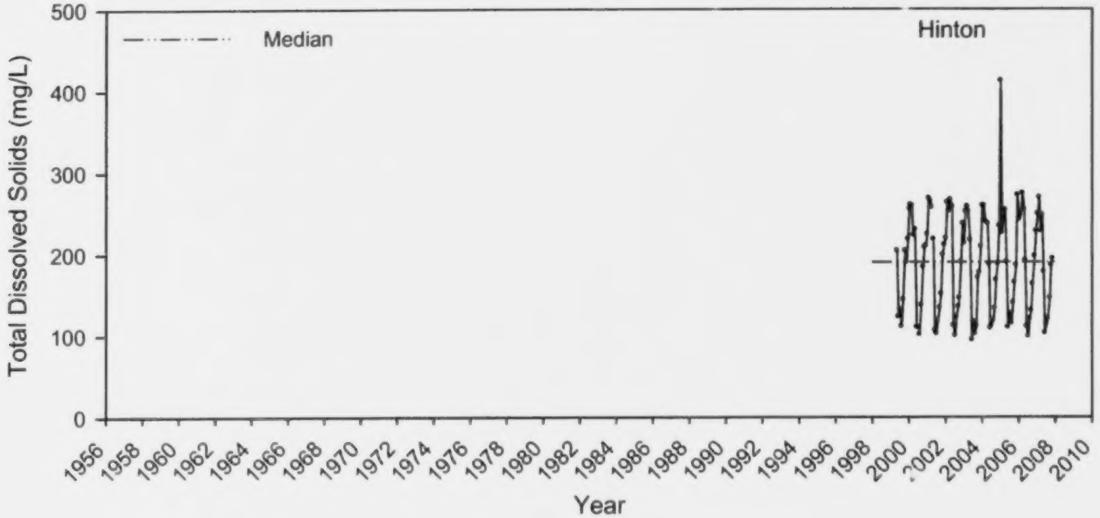
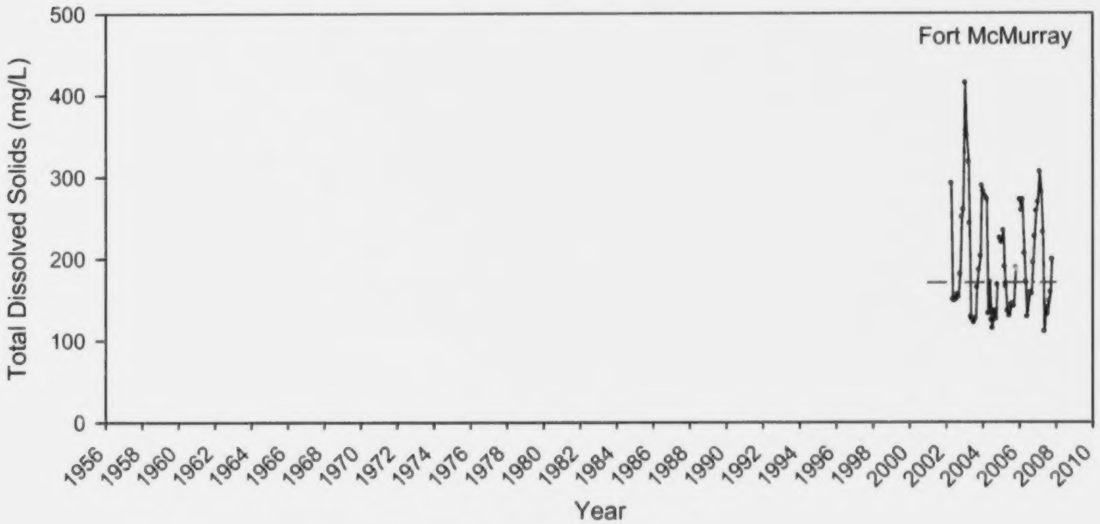


Figure 47 Seasonality of total dissolved solids in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						190.00		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						170.00		
Flow Adjusted								

Figure 48 Total dissolved solids in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

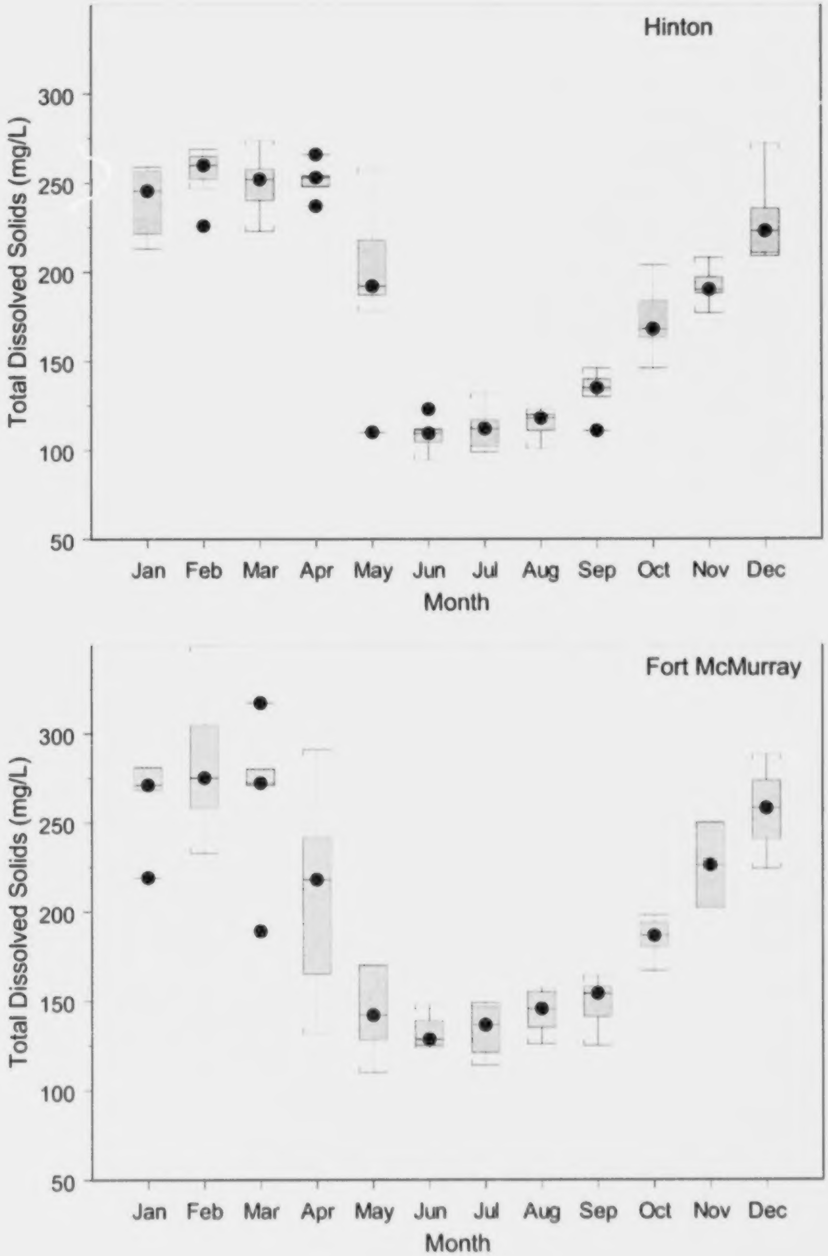
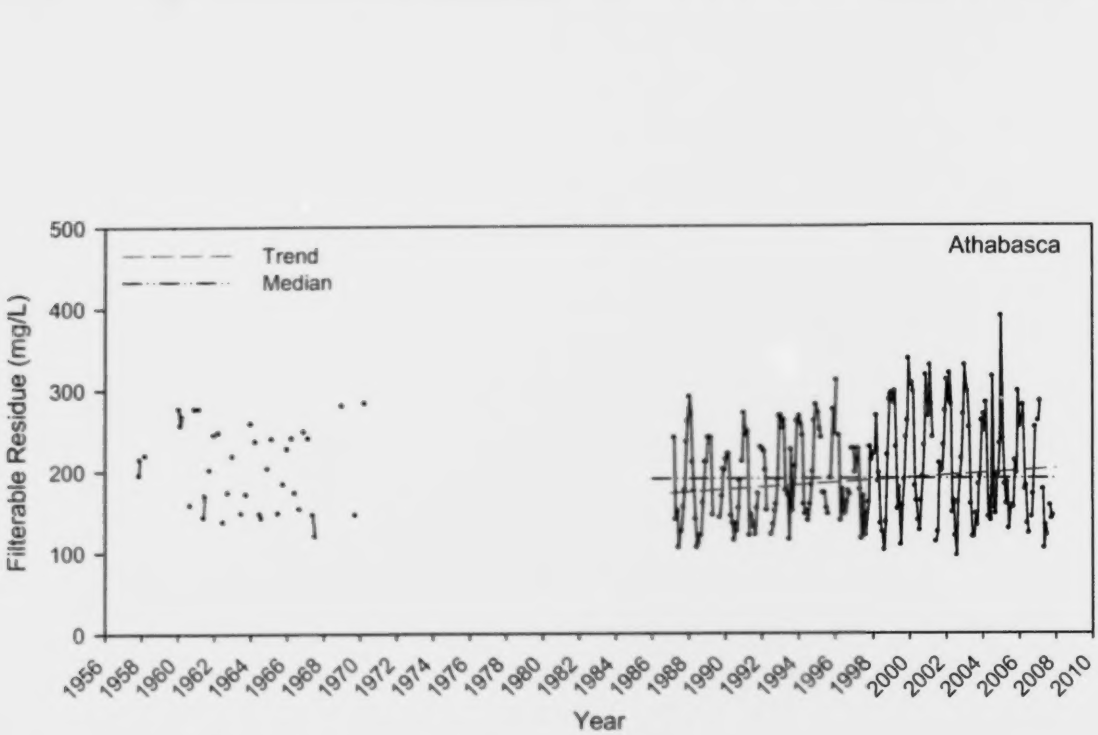
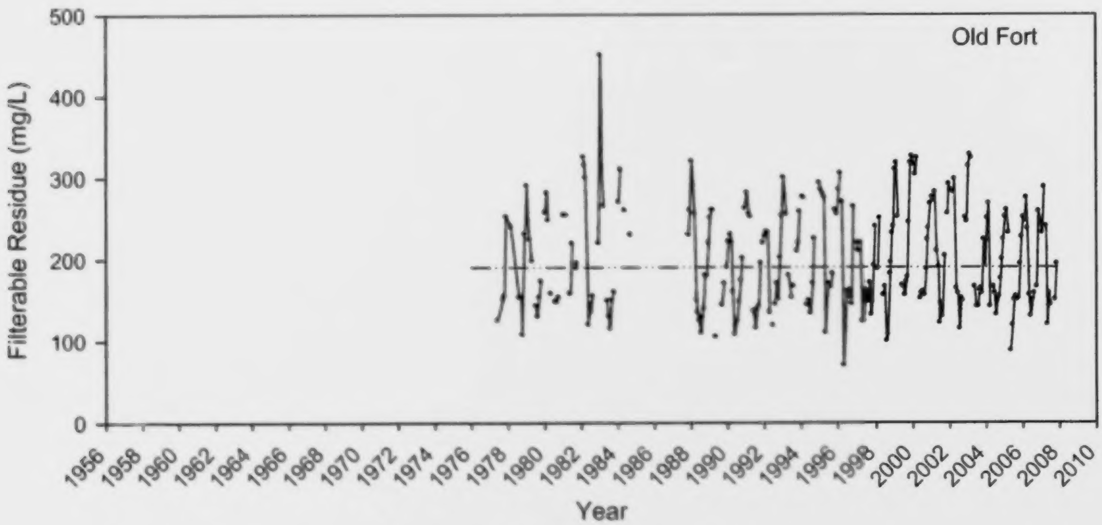


Figure 49 Seasonality of total dissolved solids in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	ID	203.00	ID	ID	187.00	1.4105	up
Flow Adjusted								
ID	ID			ID	ID		1.3815	up



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.2500	NS	NS	189.00	ID	ID	186.00	0.5000	NS
Flow Adjusted								
-0.2852	NS			ID	ID		0.4309	NS

Figure 50 Filterable residue in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

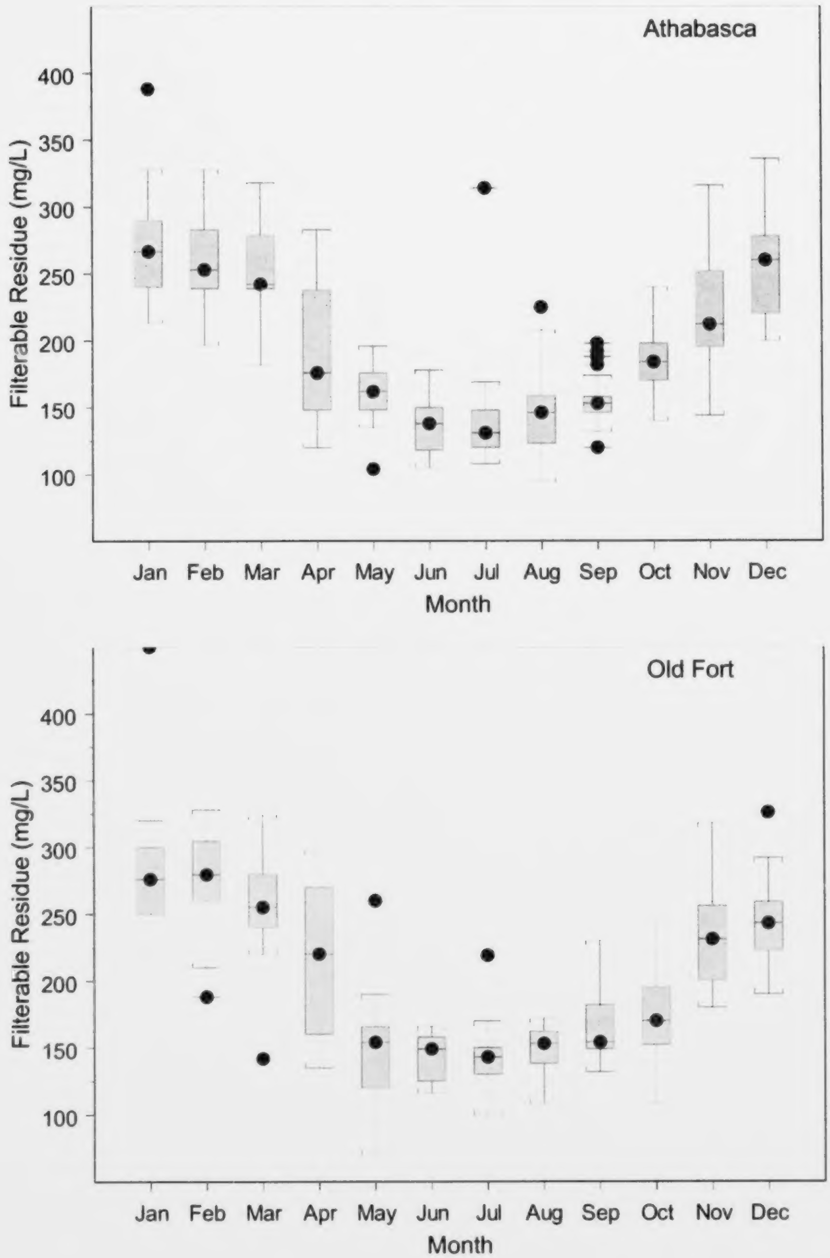
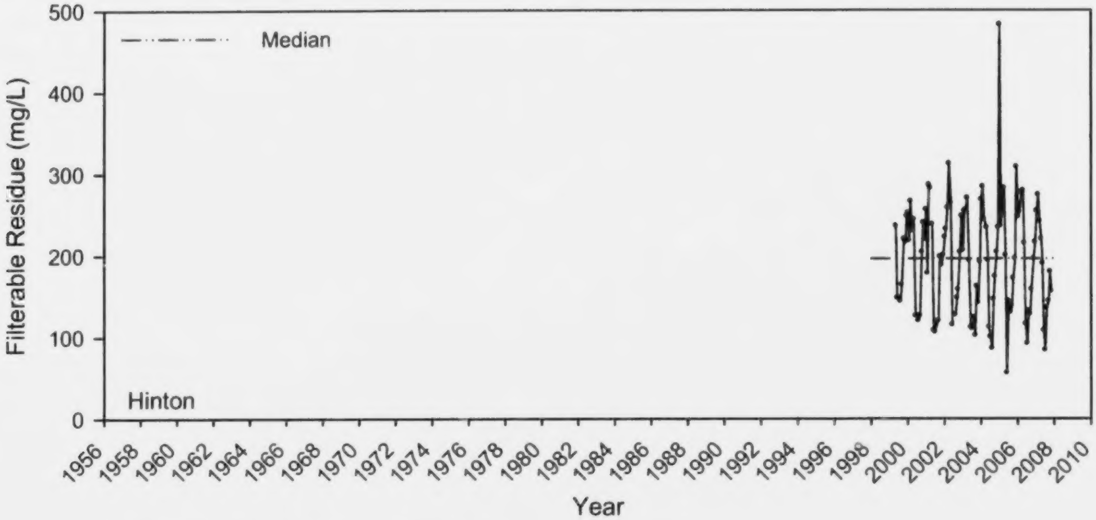
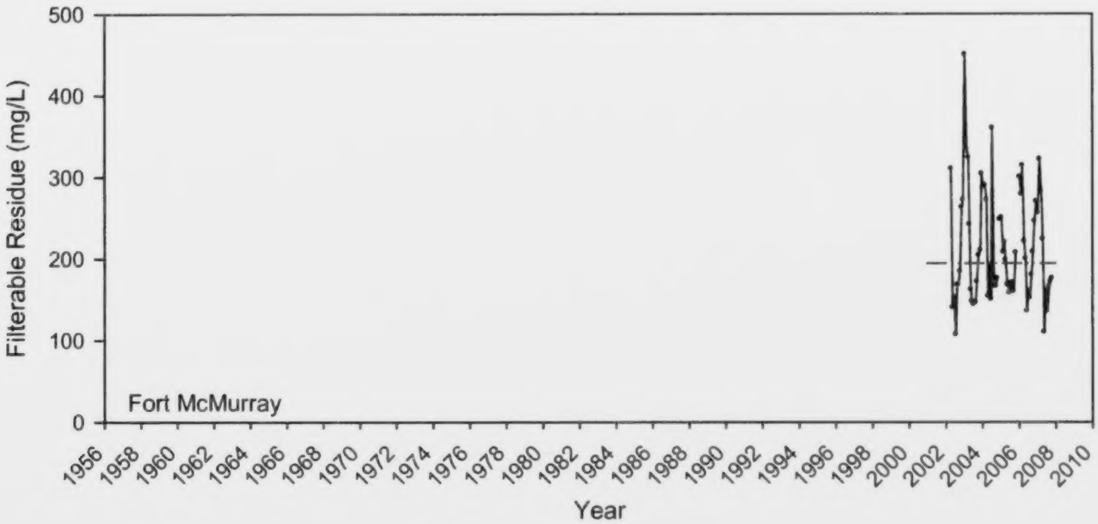


Figure 51 Seasonality of filterable residue in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						196.00		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						194.00		
Flow Adjusted								

Figure 52 Filterable residue in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.

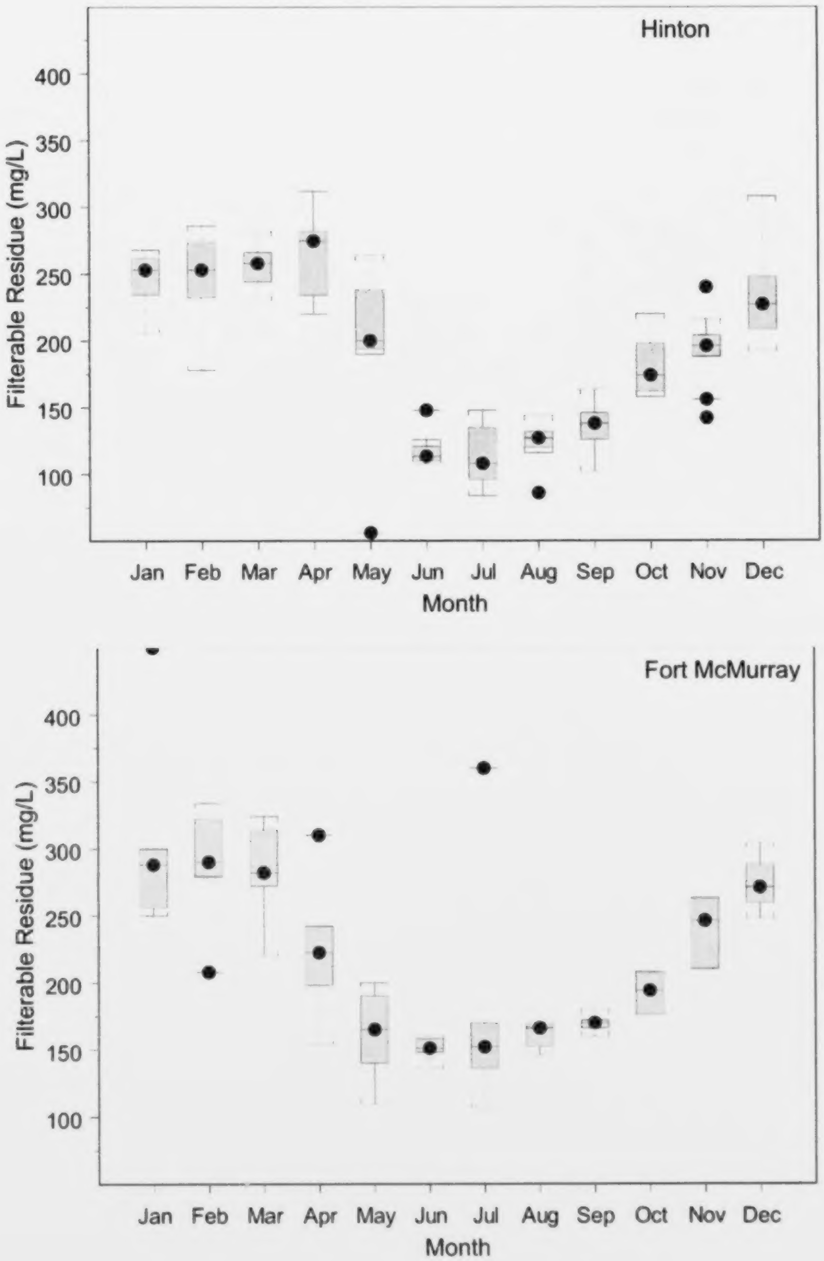
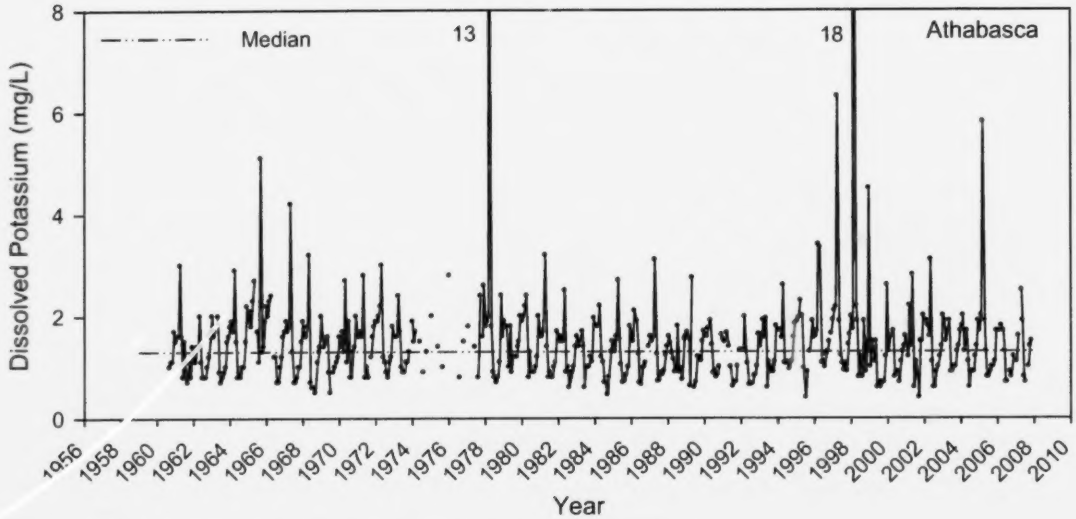
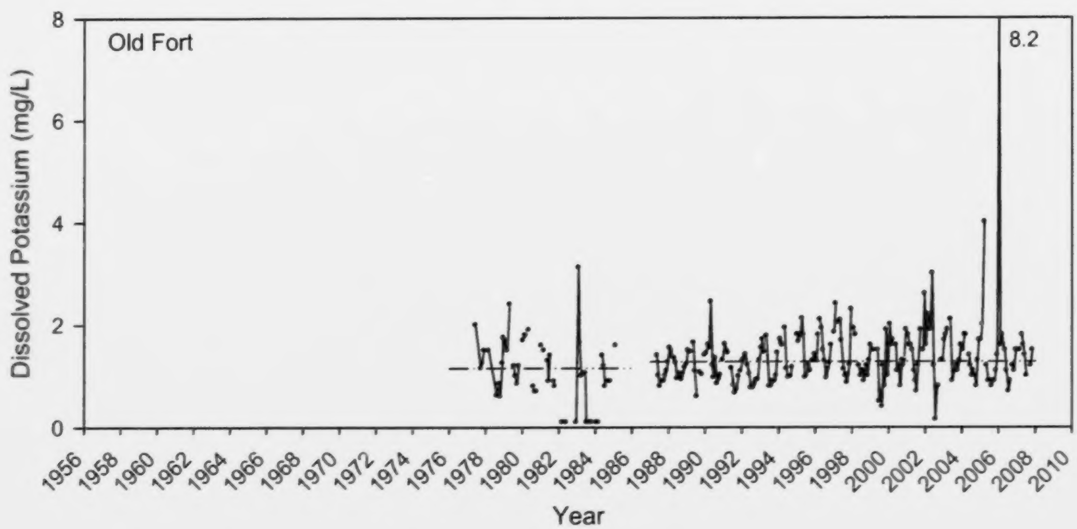


Figure 53 Seasonality of filterable residue in the Athabasca River at Hinton and Fort McMurray. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0000	NS	NS	1.40	0.0000	NS	1.30	0.0037	NS
Flow Adjusted								
-0.0017	NS			-0.0022	NS		0.0071	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	up	1.15	ID	ID	1.28	0.0100	NS
Flow Adjusted								
ID	ID			ID	ID		0.0099	NS

Figure 54 Dissolved potassium concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

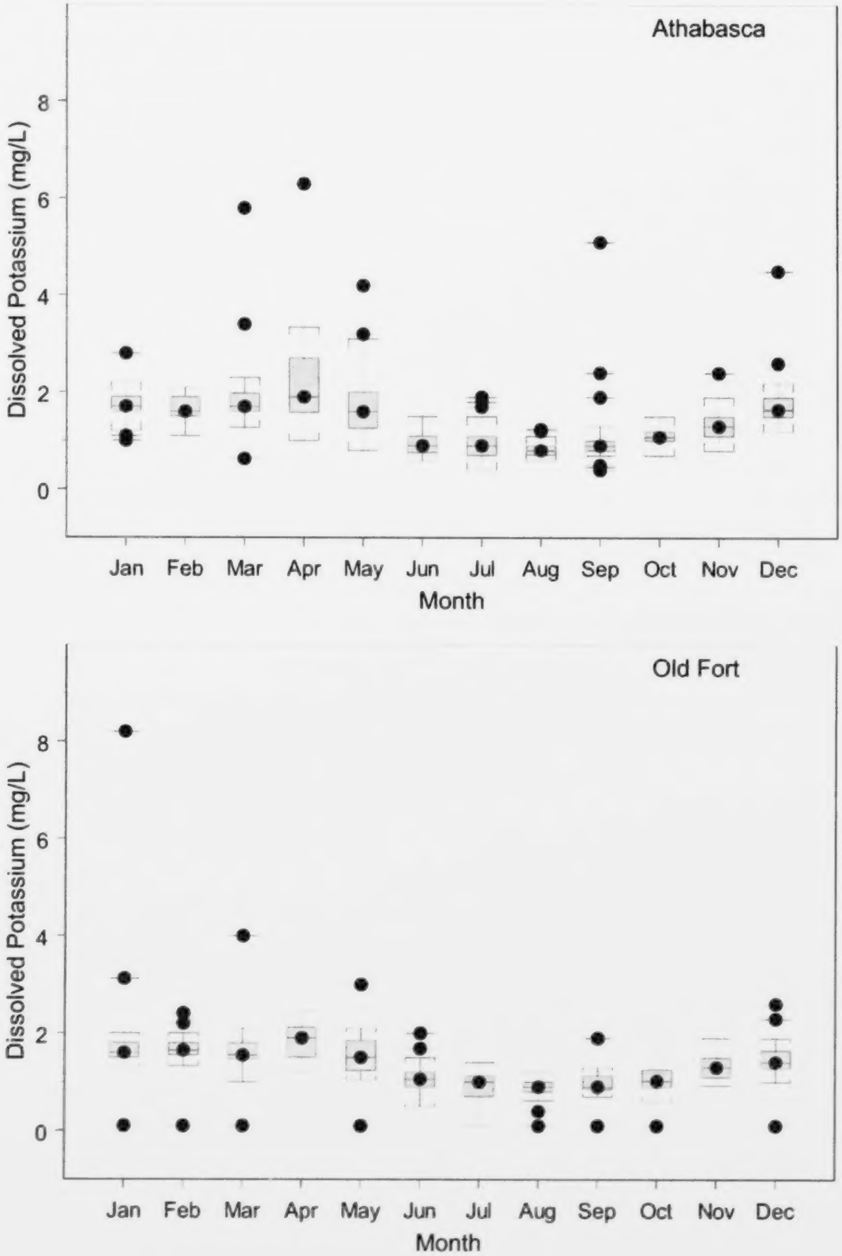
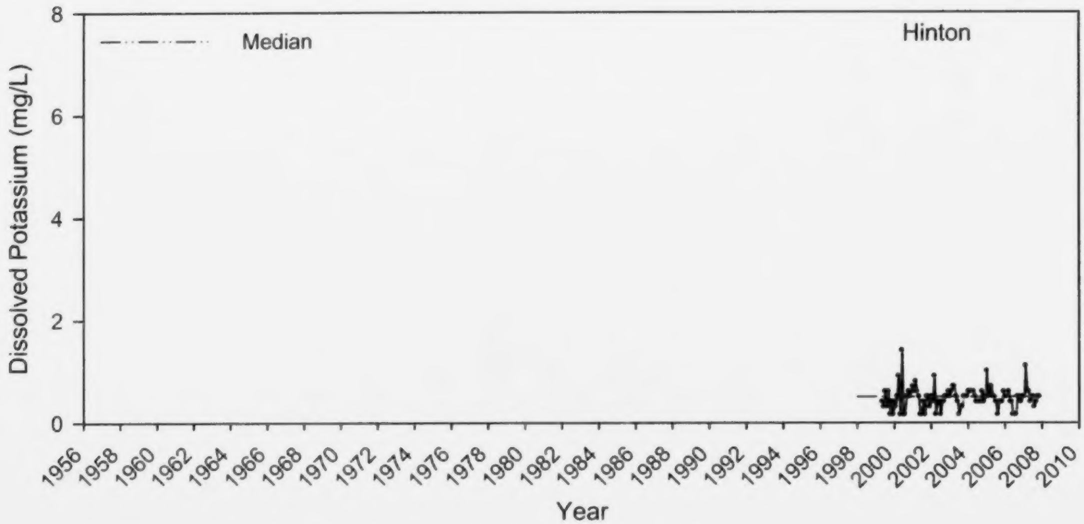
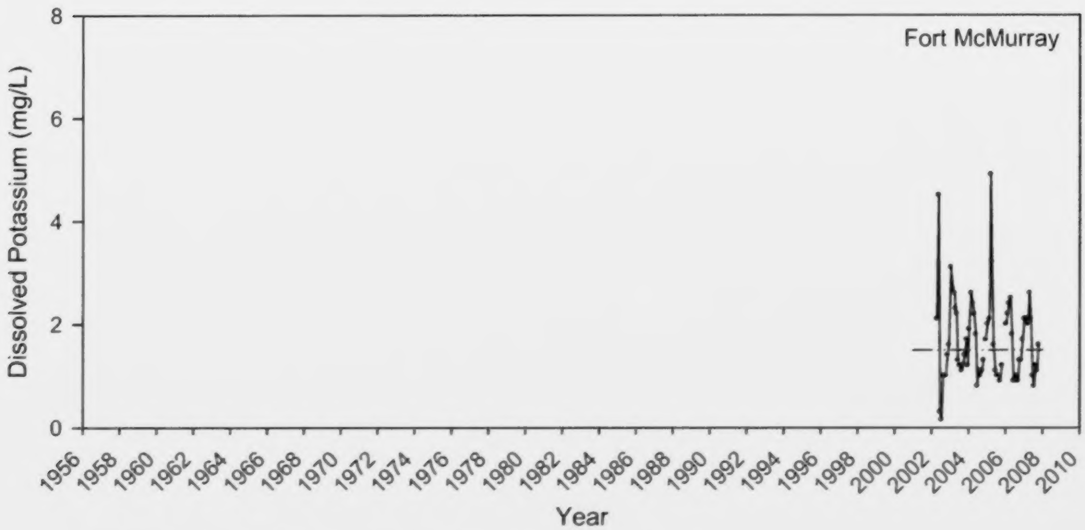


Figure 55 Seasonality of dissolved potassium concentration in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.50		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						1.50		
Flow Adjusted								

Figure 56 Dissolved potassium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

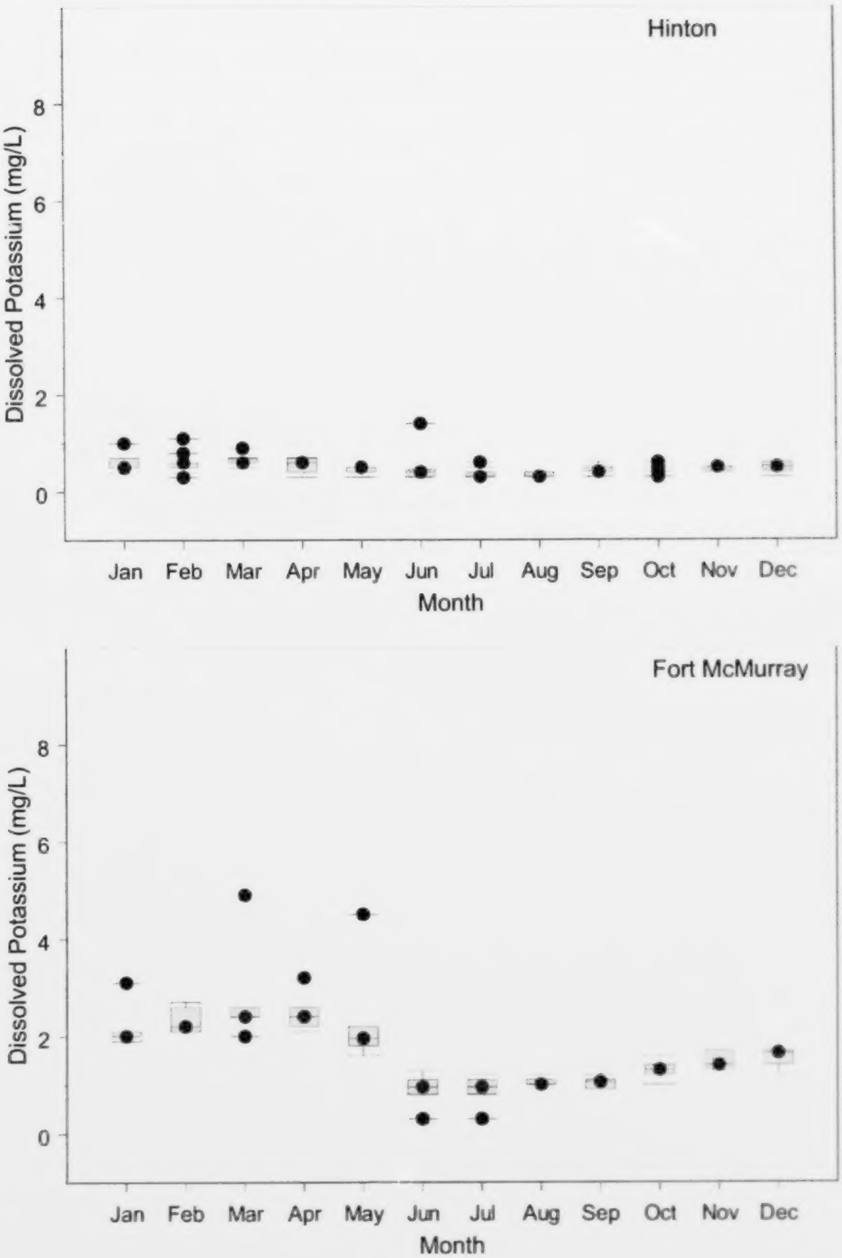
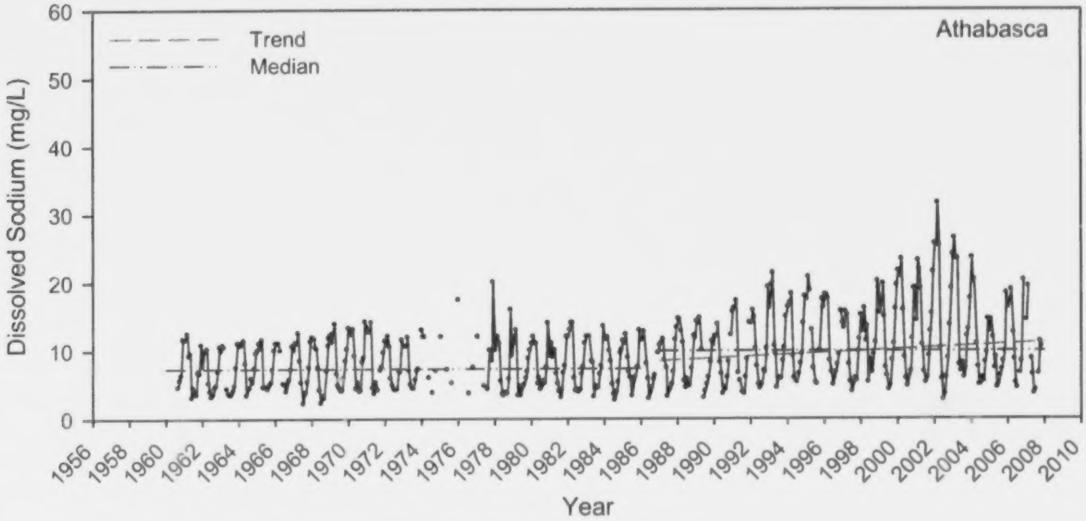
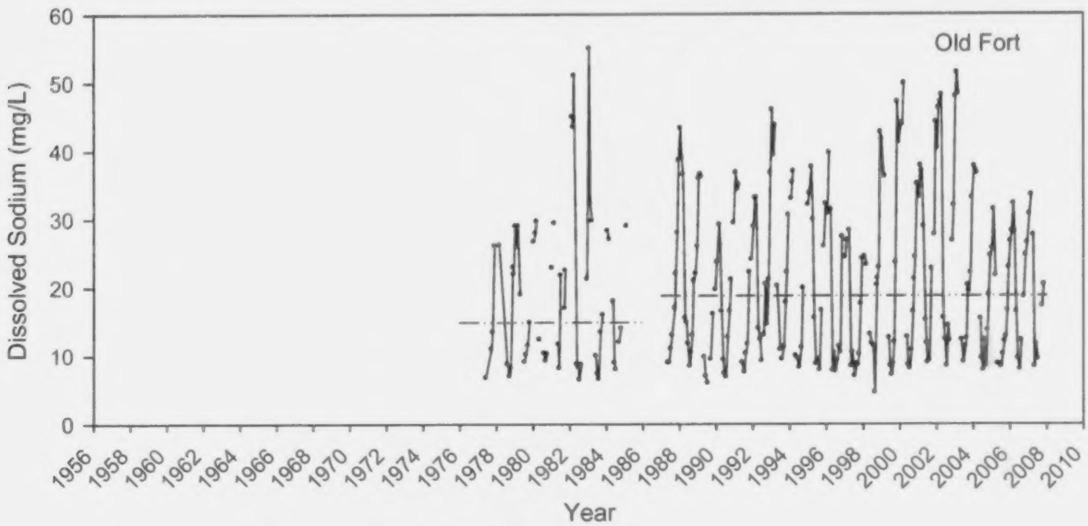


Figure 57 Seasonality of dissolved potassium in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0860	up	up	7.30	0.0227	NS	9.90	0.1288	up
Flow Adjusted								
0.0944	up			0.0633	up		0.1176	up



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0772	NS	up	14.90	ID	ID	18.75	0.0286	NS
Flow Adjusted								
0.0001	NS			ID	ID		-0.0245	NS

Figure 58 Dissolved sodium concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., p<0.05). ID = Insufficient Data. NS = Not Significant.

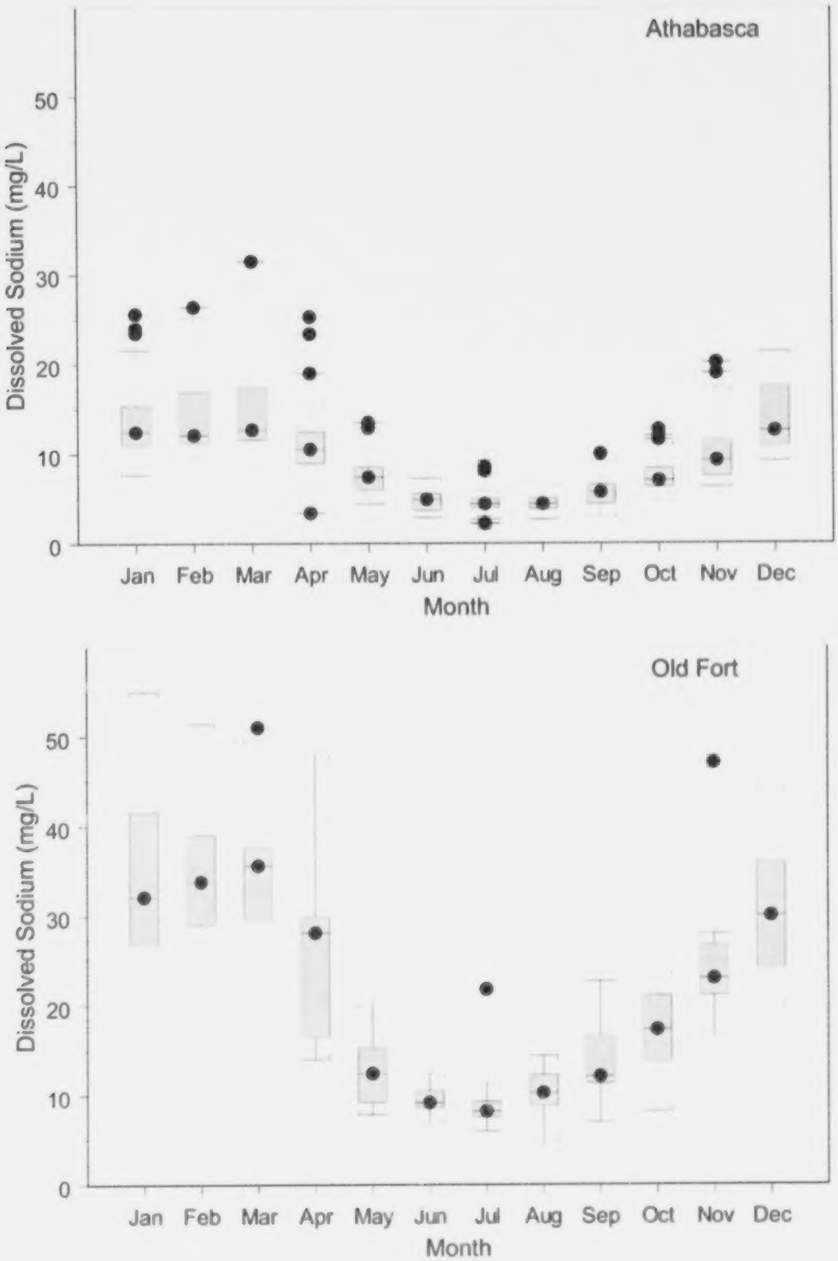
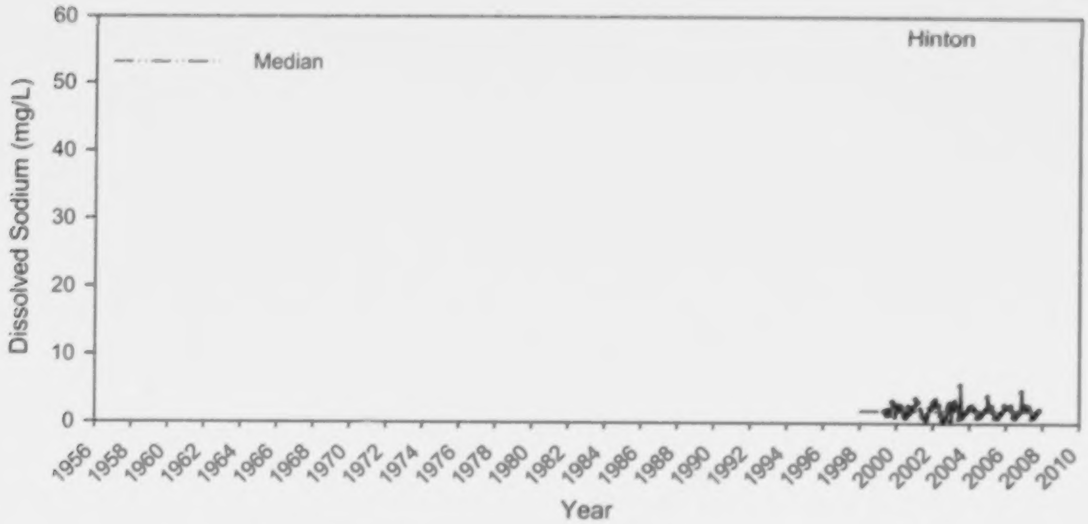
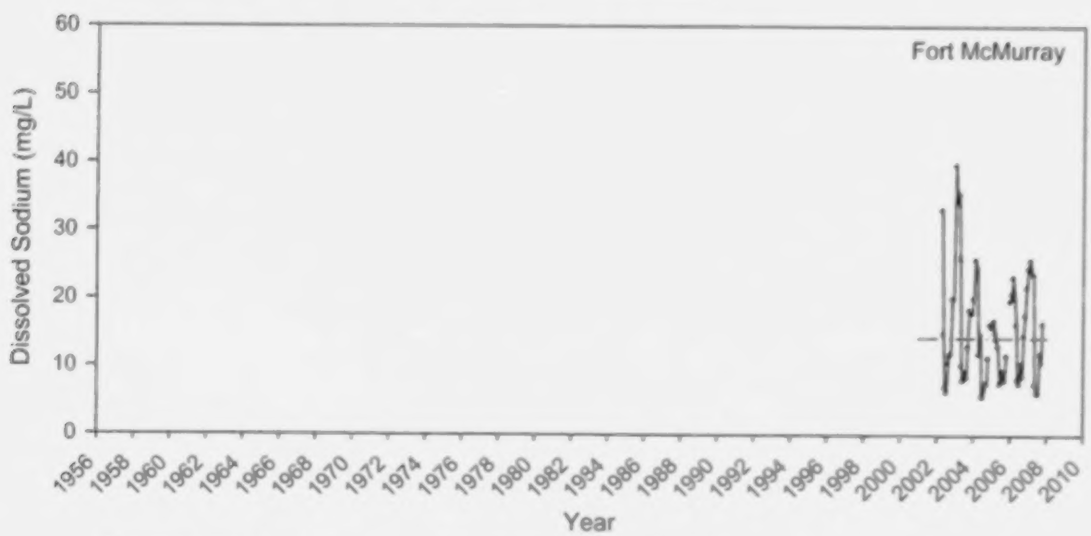


Figure 59 Seasonality of dissolved sodium concentration in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						1.80		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						14.30		
Flow Adjusted								

Figure 60 Dissolved sodium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

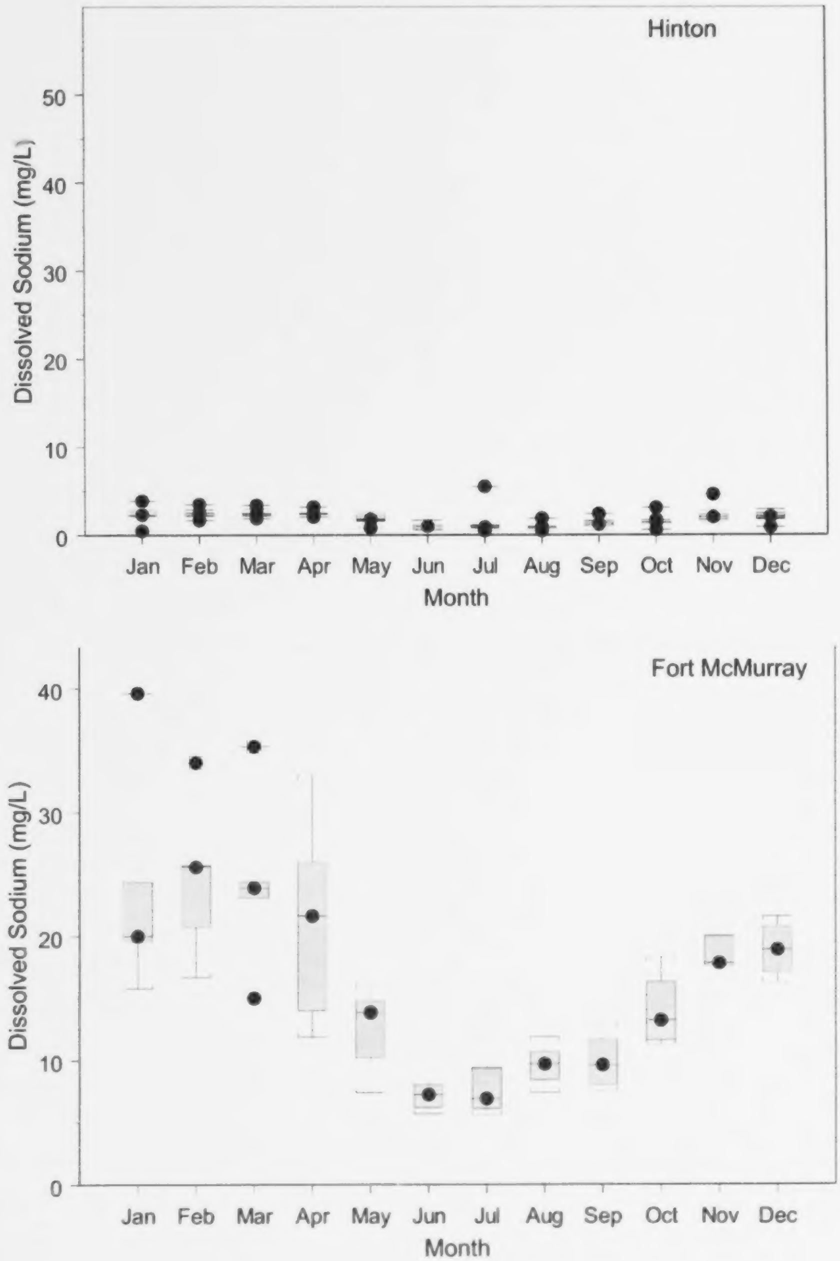
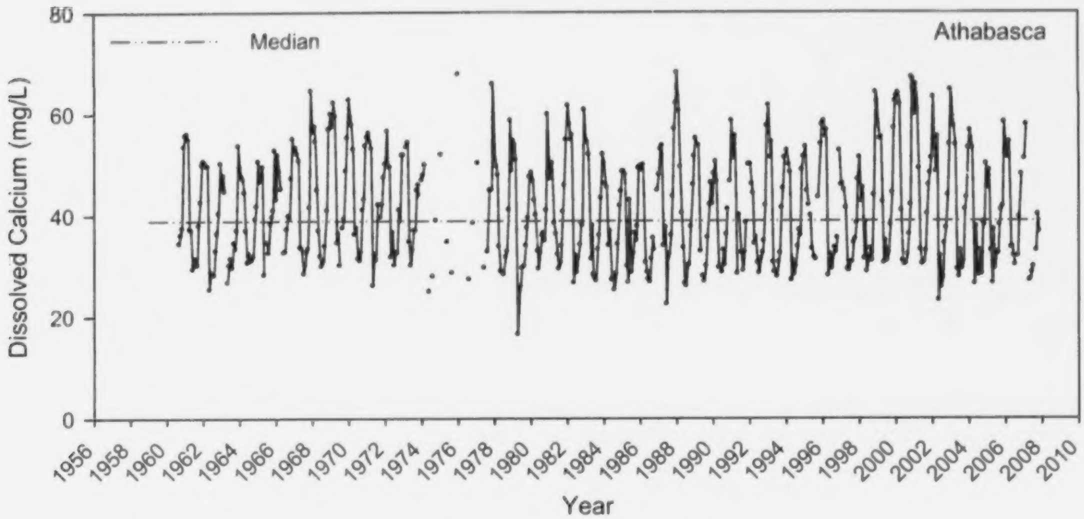
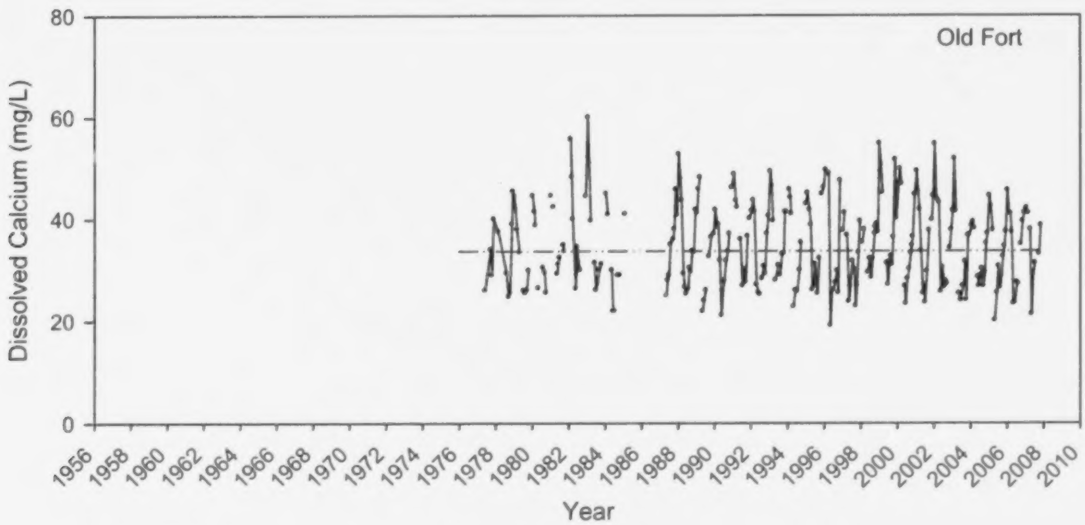


Figure 61 Seasonality of dissolved sodium in the Athabasca River at Hinton and Fort McMurray. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trends			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig.	Median	Slope	Sig
0.0154	NS	NS	38.90	-0.0512	NS	38.50	0.0800	NS
Flow Adjusted								
-0.0108	NS			-0.0021	NS		0.0205	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig.	Median	Slope	Sig.
-0.0320	NS	NS	31.60	ID	ID	33.70	-0.0750	NS
Flow Adjusted								
-0.0920	down			ID	ID		-0.1078	NS

Figure 62 Dissolved calcium concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

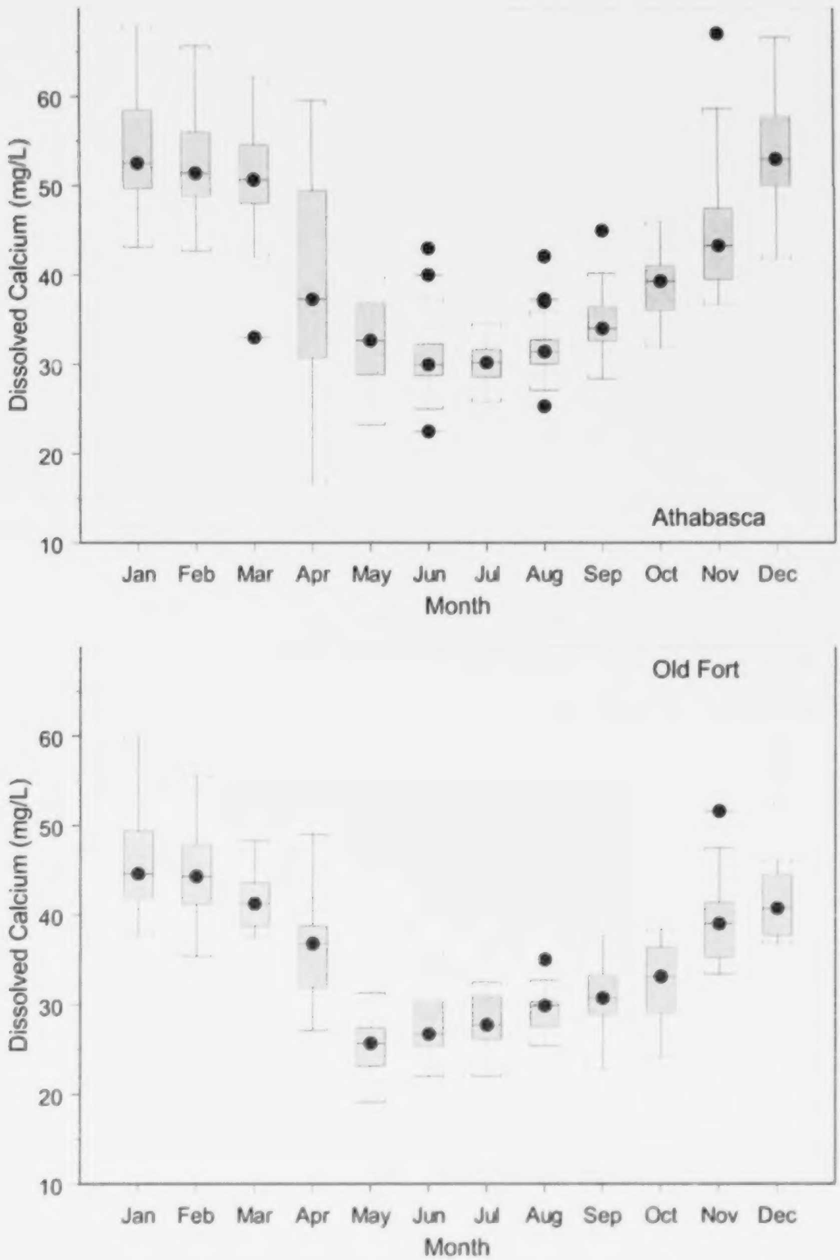
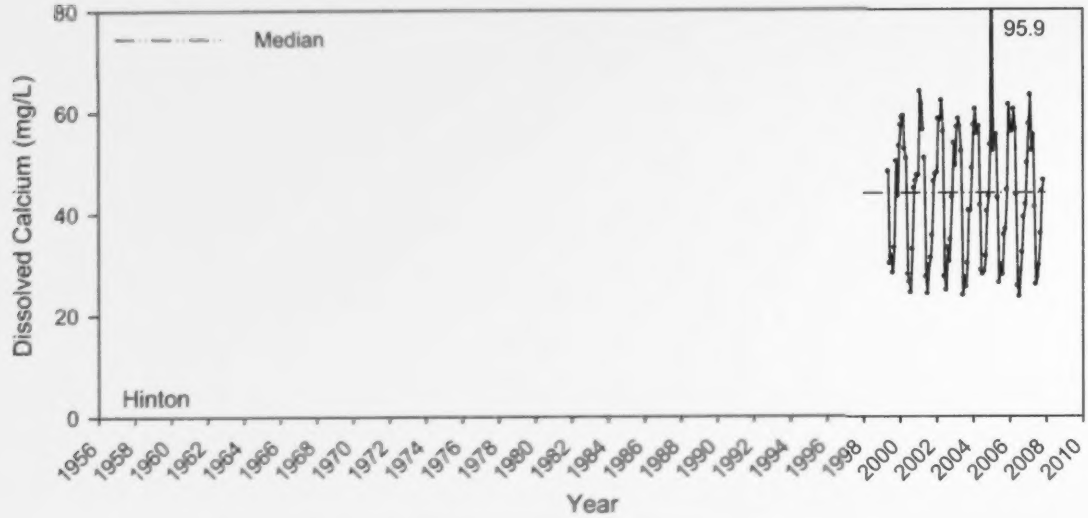
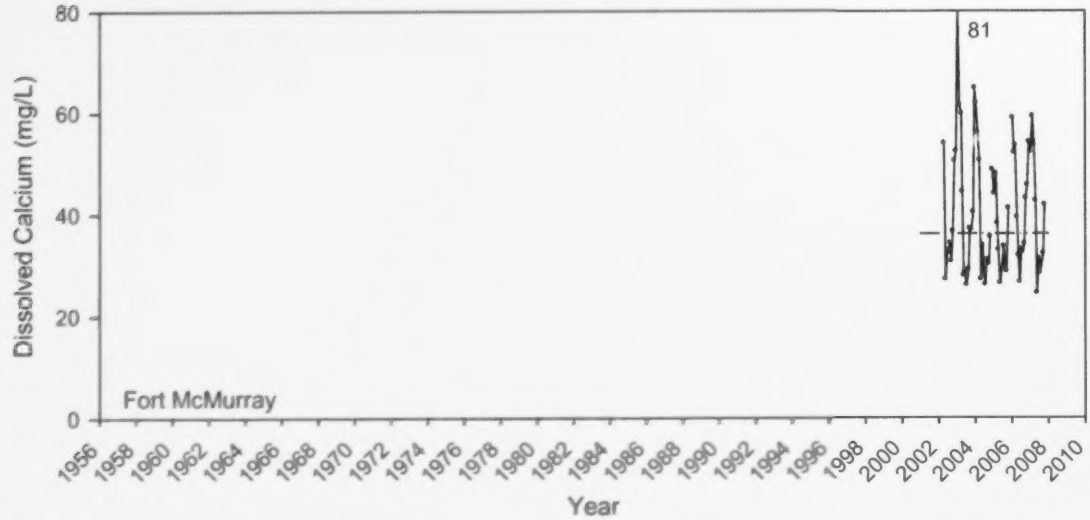


Figure 63 Seasonality of dissolved calcium in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						43.90		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						36.10		
Flow Adjusted								

Figure 64 Dissolved calcium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

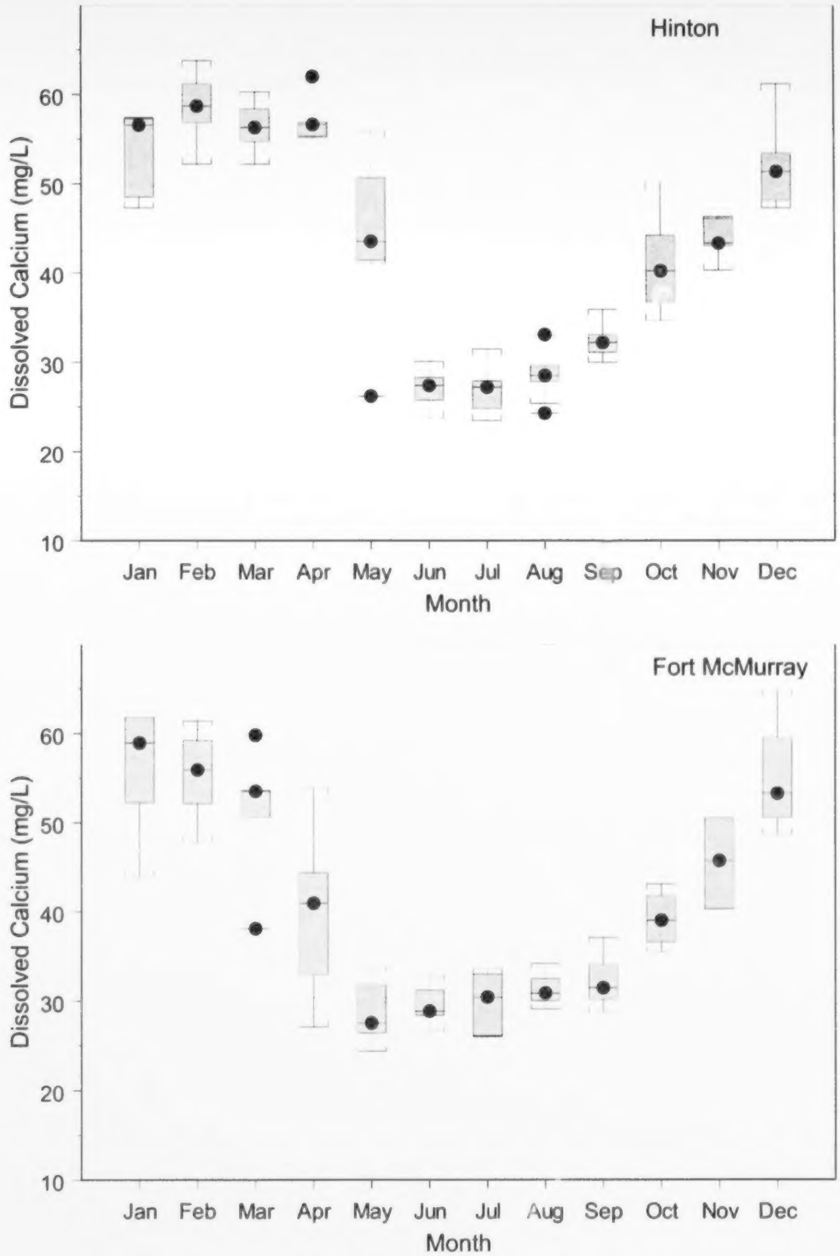
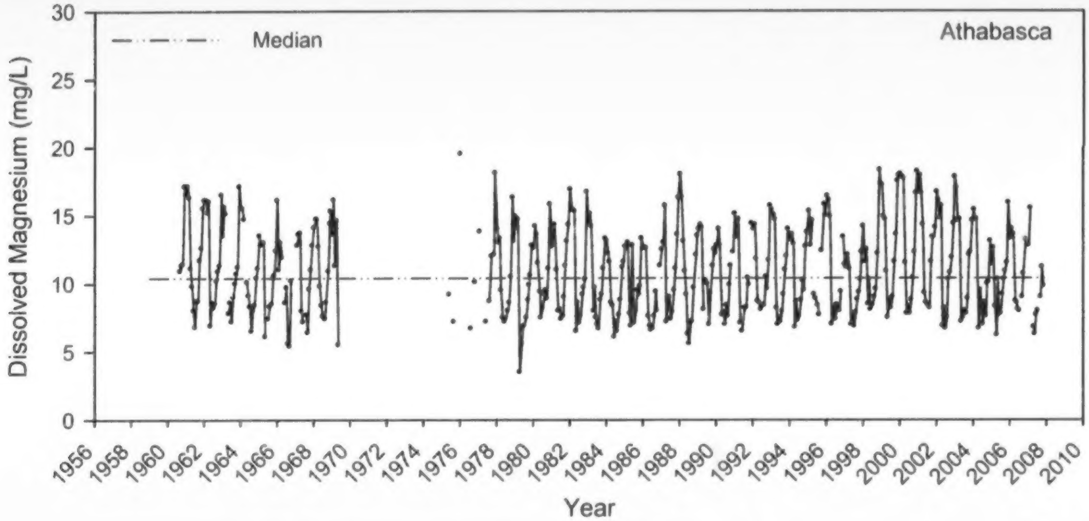
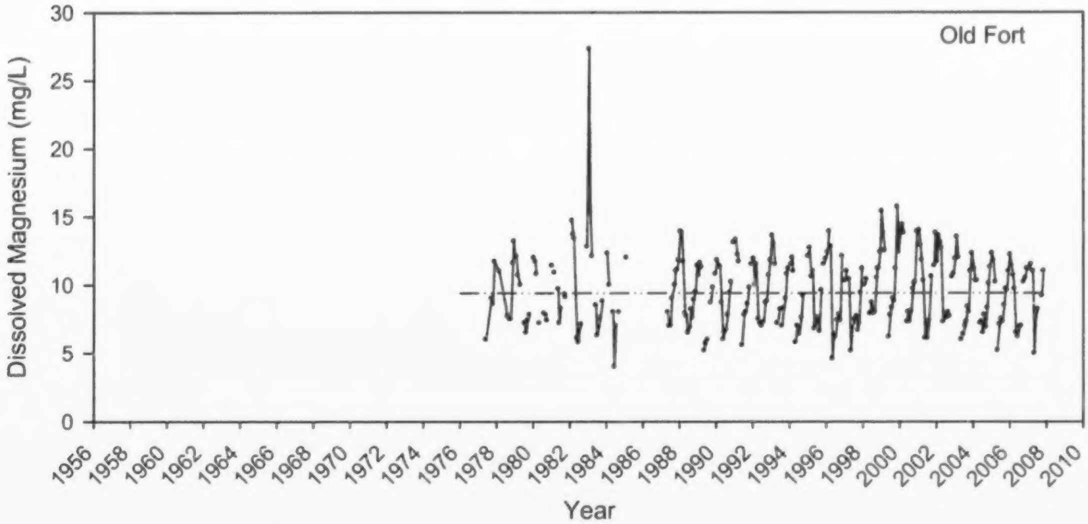


Figure 65 Seasonality of dissolved calcium in the Athabasca River at Hinton and Fort McMurray. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0357	up	up	10.40	-0.1000	NS	10.40	0.0250	NS
Flow Adjusted								
0.0083	NS			-0.0926	down		0.0155	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0000	NS	NS	8.70	ID	ID	9.55	0.0000	NS
Flow Adjusted								
-0.0131	NS			ID	ID		-0.0067	NS

Figure 66 Dissolved magnesium concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

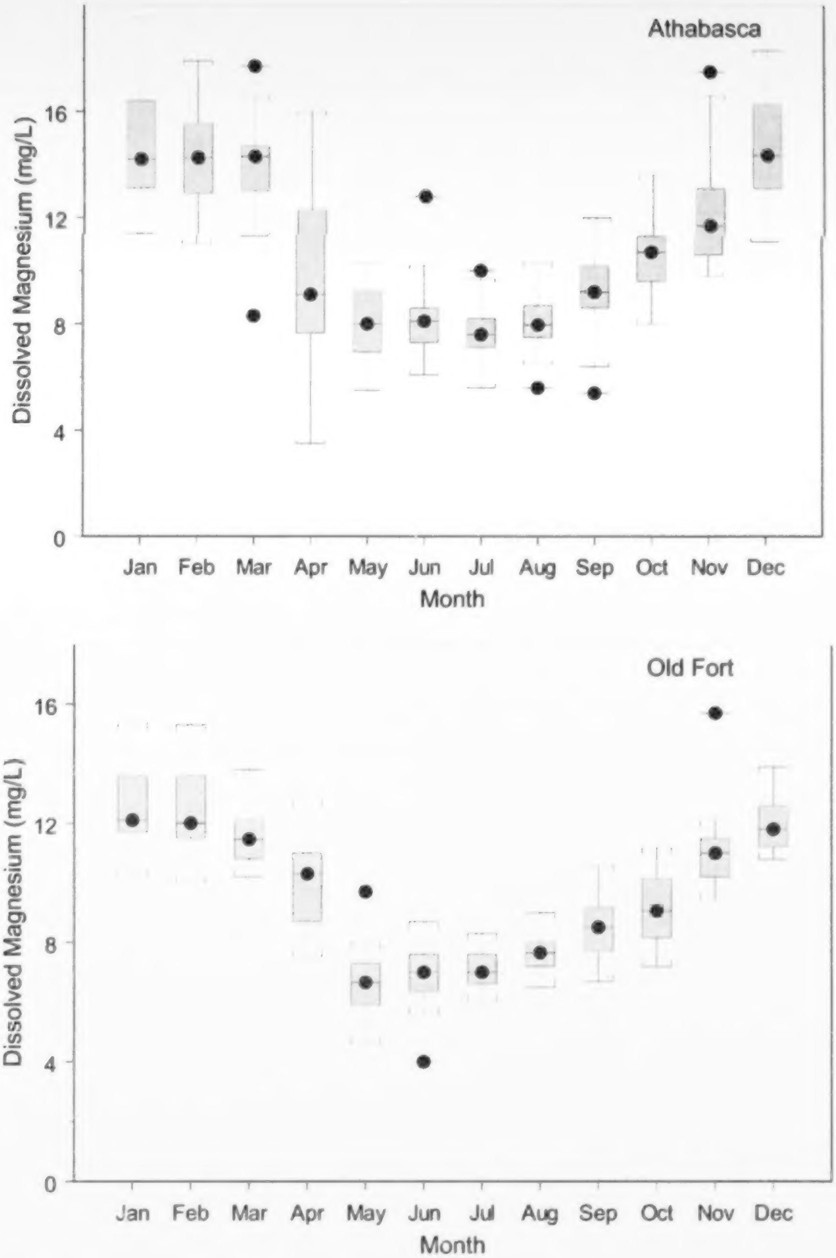
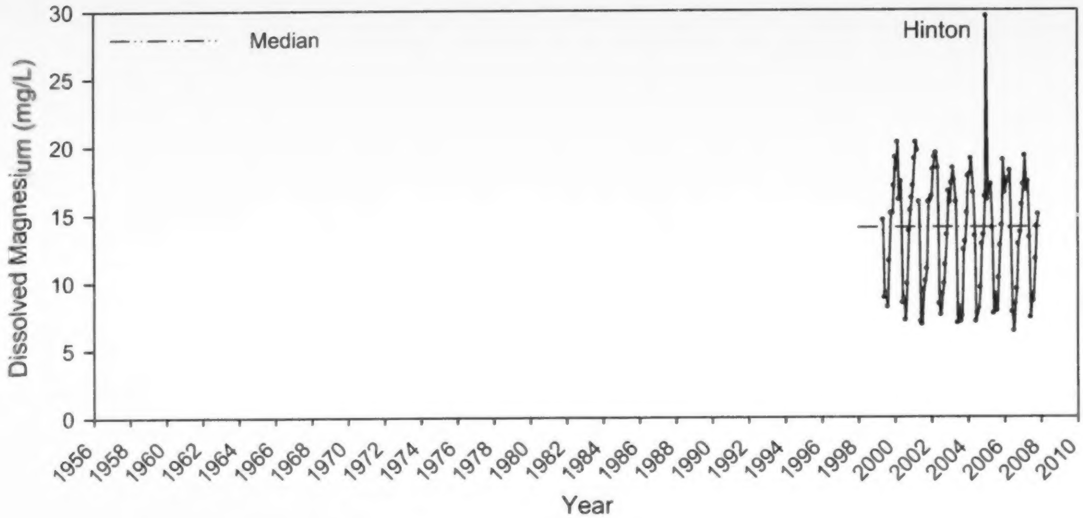
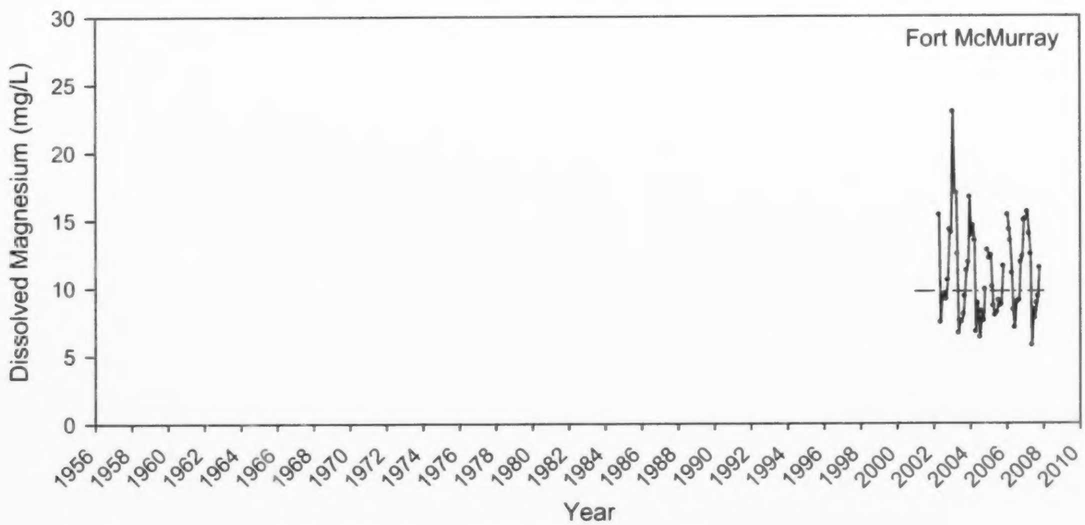


Figure 67 Dissolved magnesium concentration in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						14.00		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						36.10		
Flow Adjusted								

Figure 68 Dissolved magnesium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

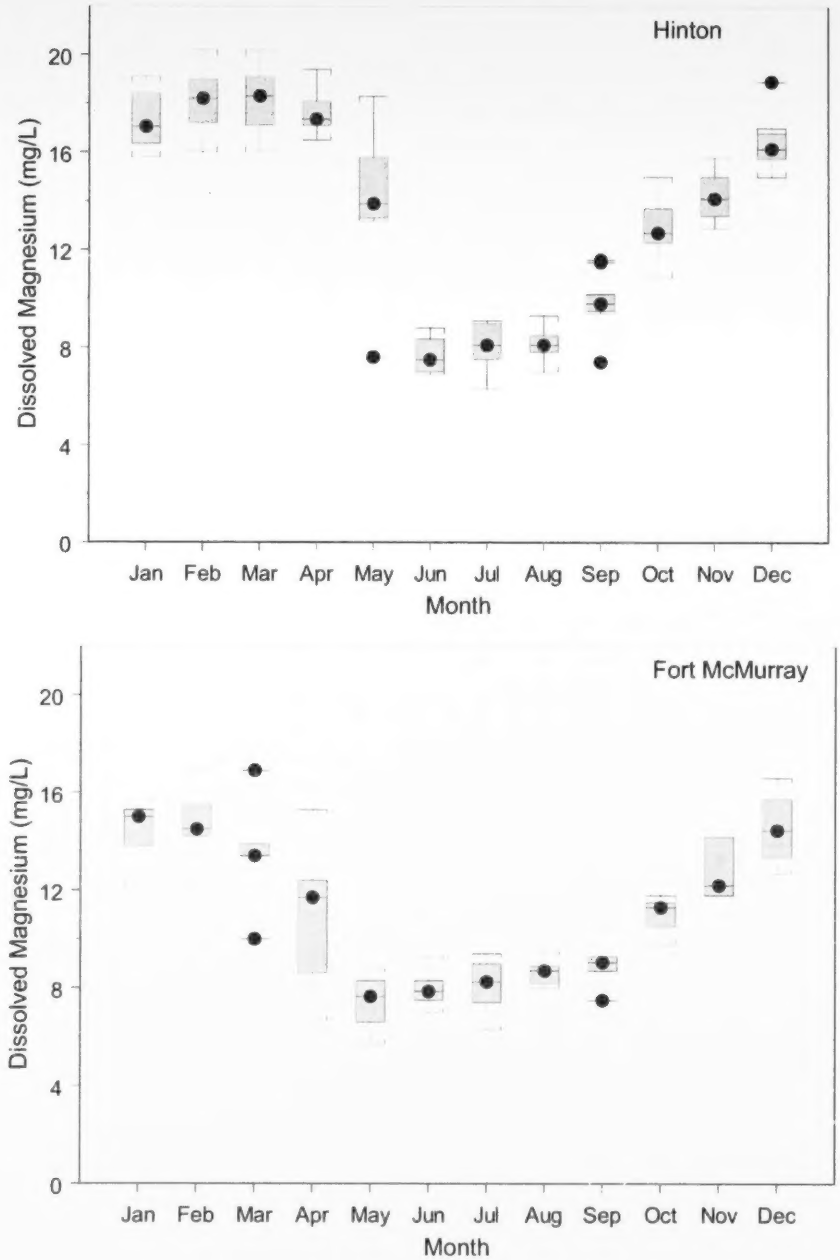
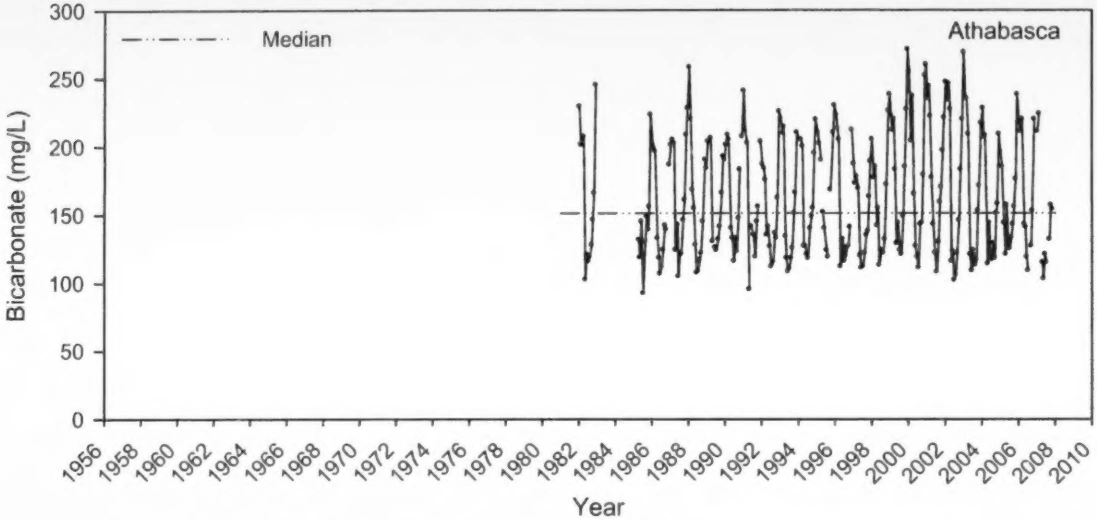
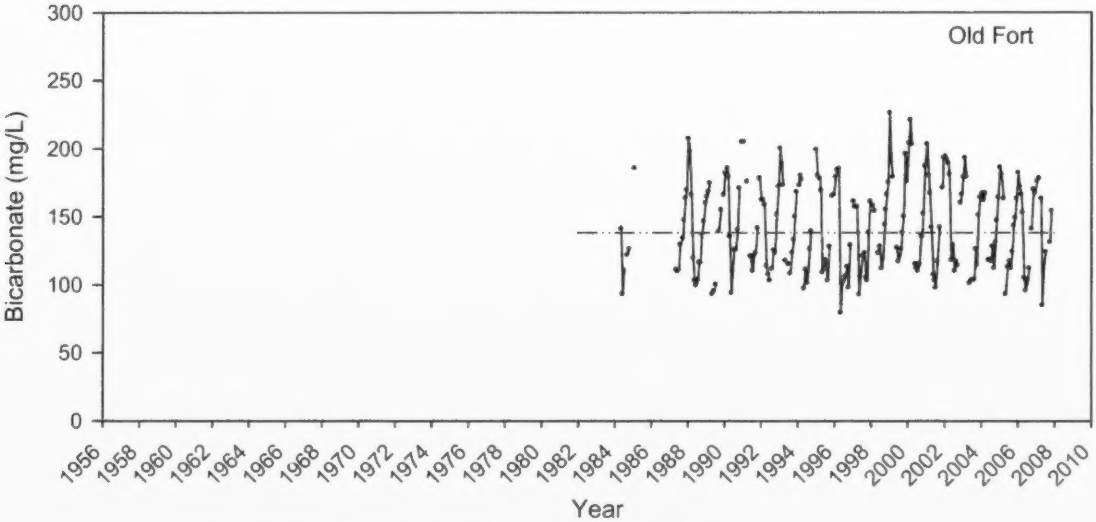


Figure 69 Seasonality of dissolved magnesium in the Athabasca River at Hinton and Fort McMurray. Some outliers may exceed axis range.

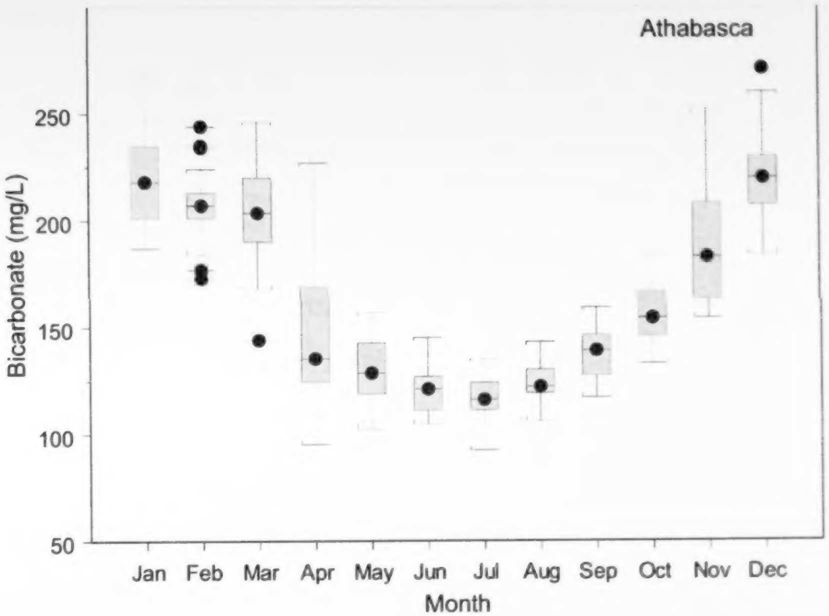


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	ID	140.55	ID	ID	153.00	0.3000	NS
Flow Adjusted								
ID	ID			ID	ID		0.2572	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	ID	123.83	ID	ID	138.97	0.0000	NS
Flow Adjusted								
ID	ID			ID	ID		-0.0271	NS

Figure 70 Bicarbonate concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.



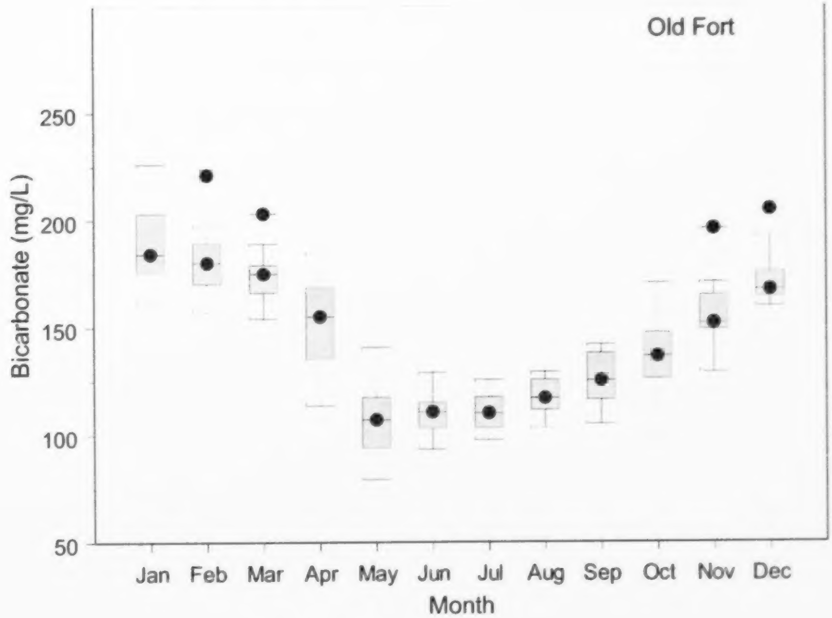
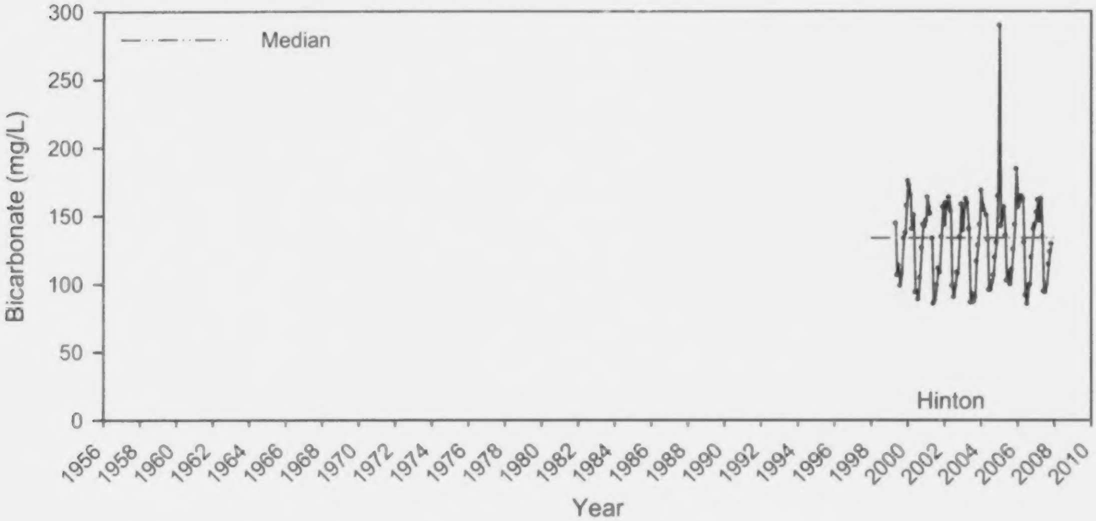
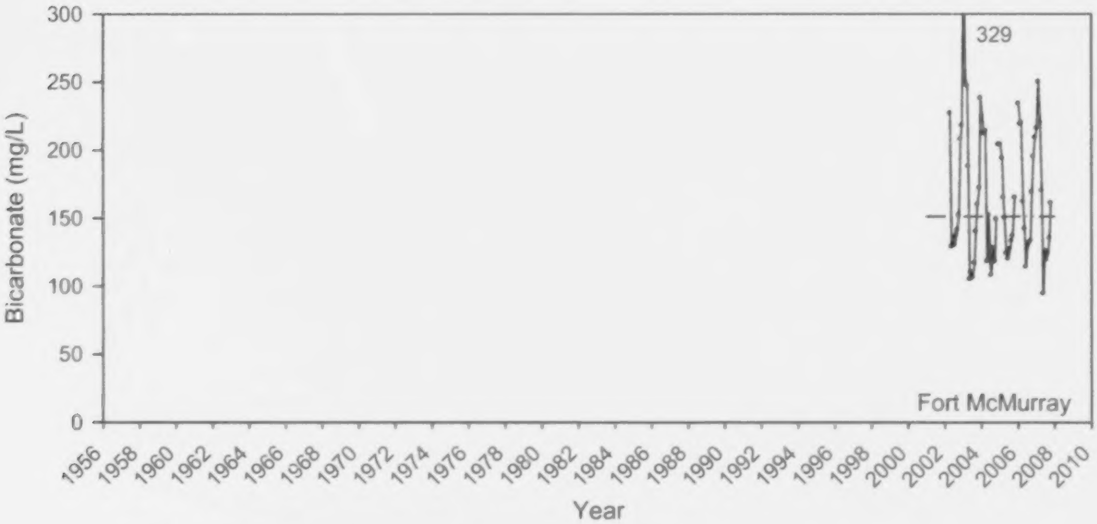


Figure 71 Seasonality of bicarbonate in the Athabasca River at Athabasca and Old Fort.

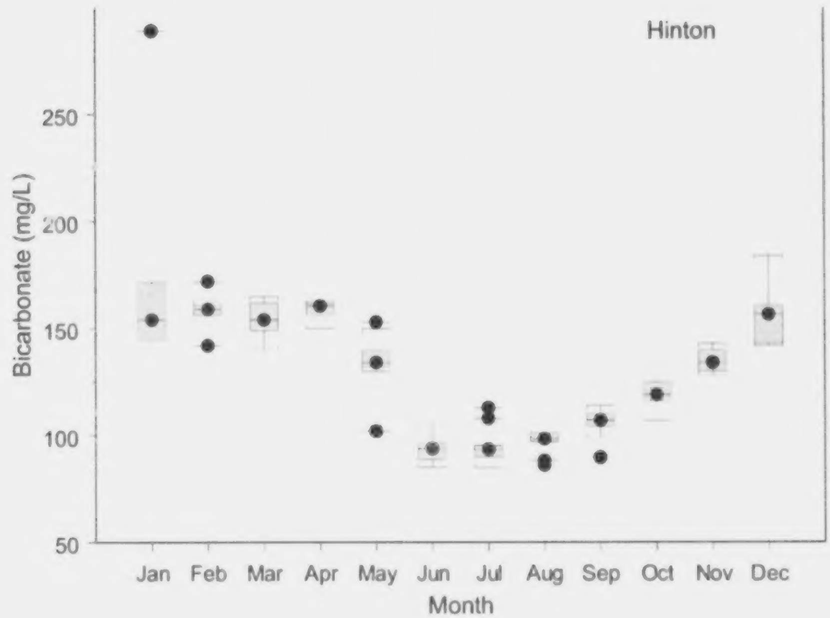


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						133.50		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						151.00		
Flow Adjusted								

Figure 72 Bicarbonate concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.



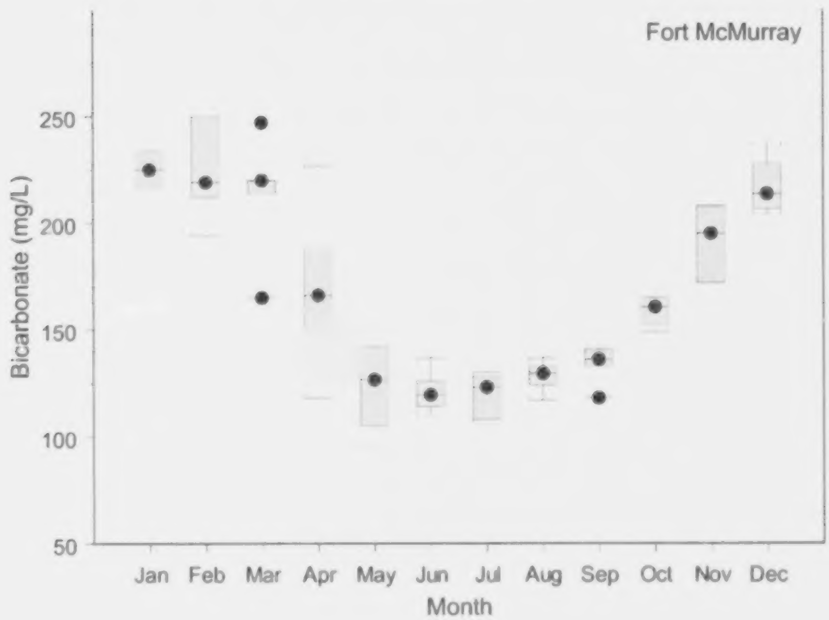
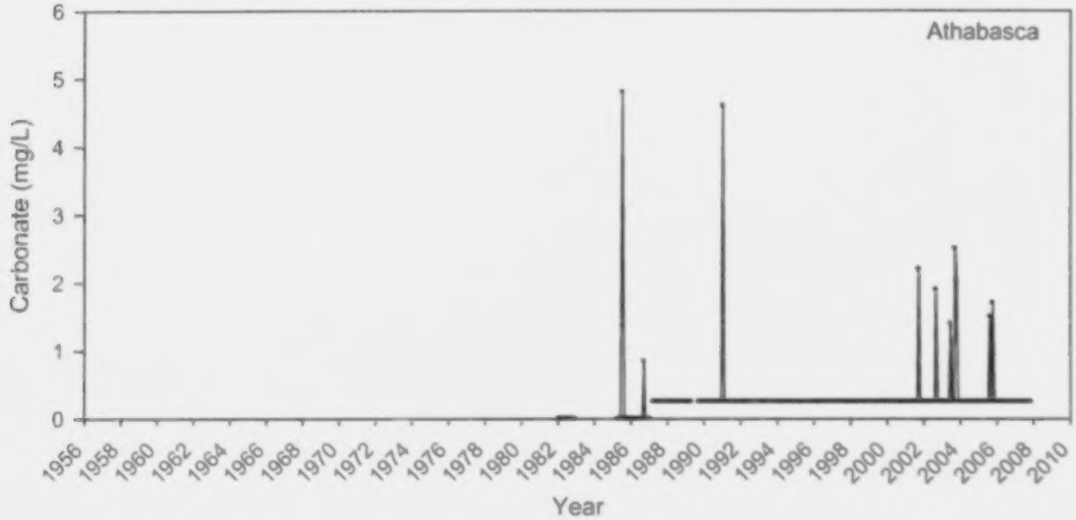
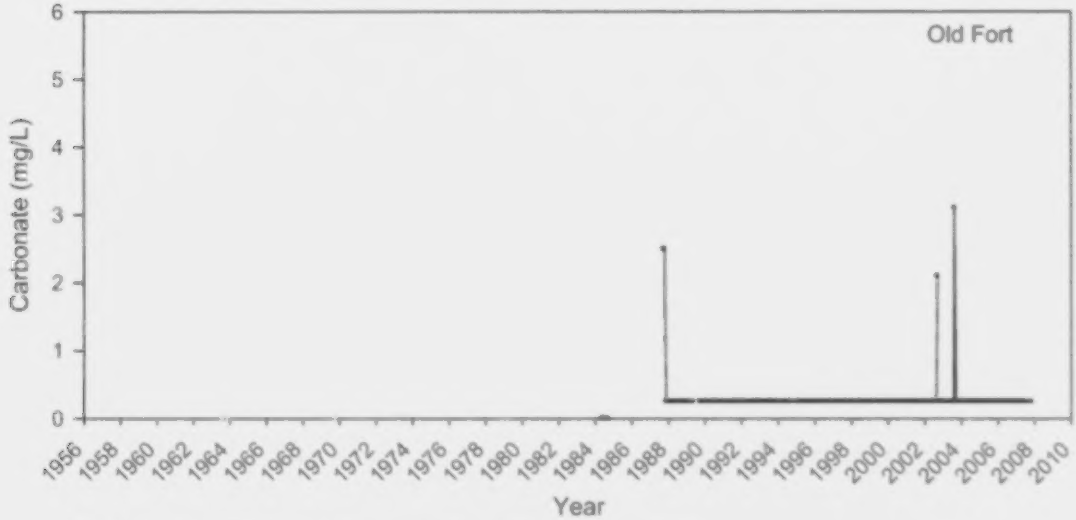


Figure 73 Seasonality of bicarbonate concentration in the Athabasca River at Hinton and Fort McMurray. Some outliers may exceed axis range.

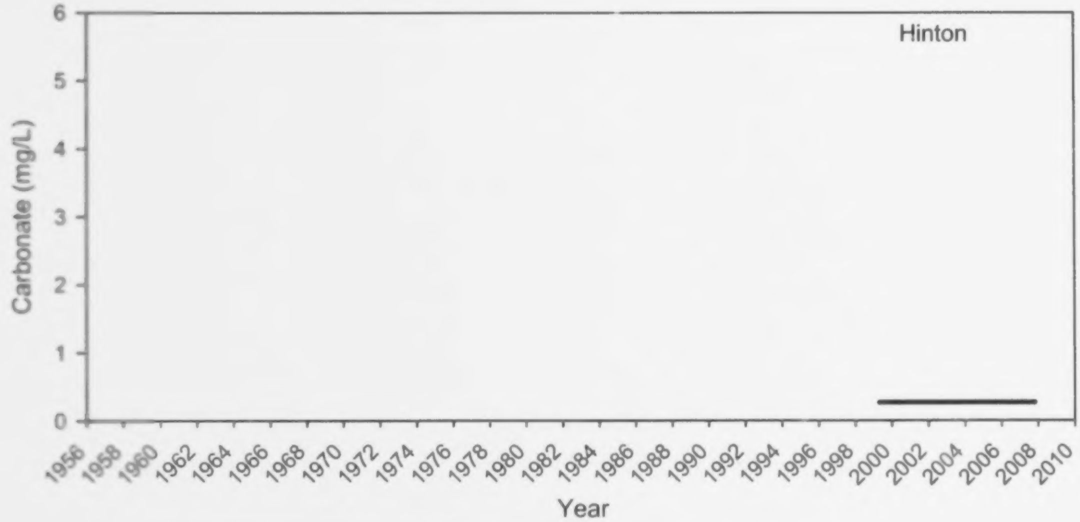


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.25		
Flow Adjusted								

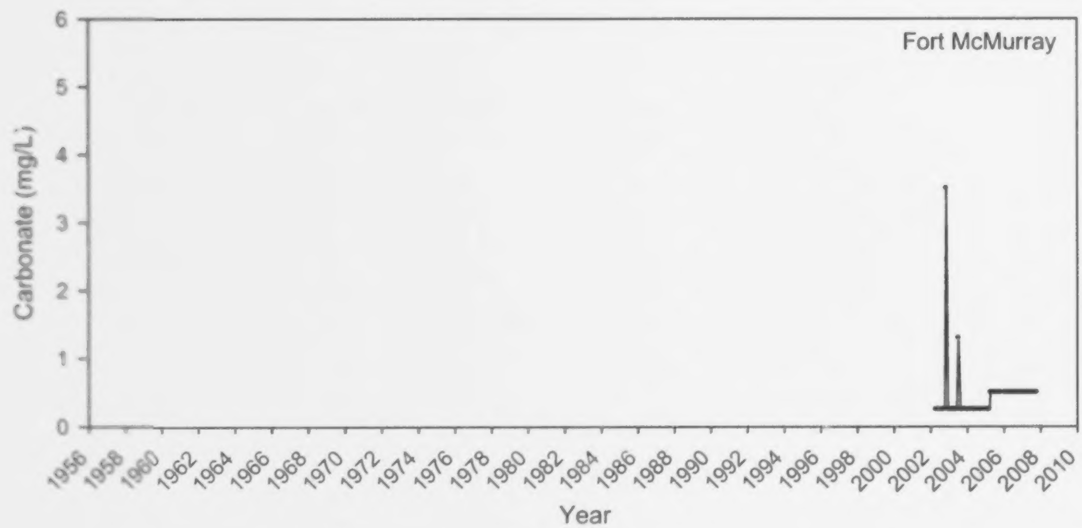


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.25		
Flow Adjusted								

Figure 74 Carbonate concentration in the Athabasca River at Hinton and Old Fort. Data are insufficient for trend analysis.

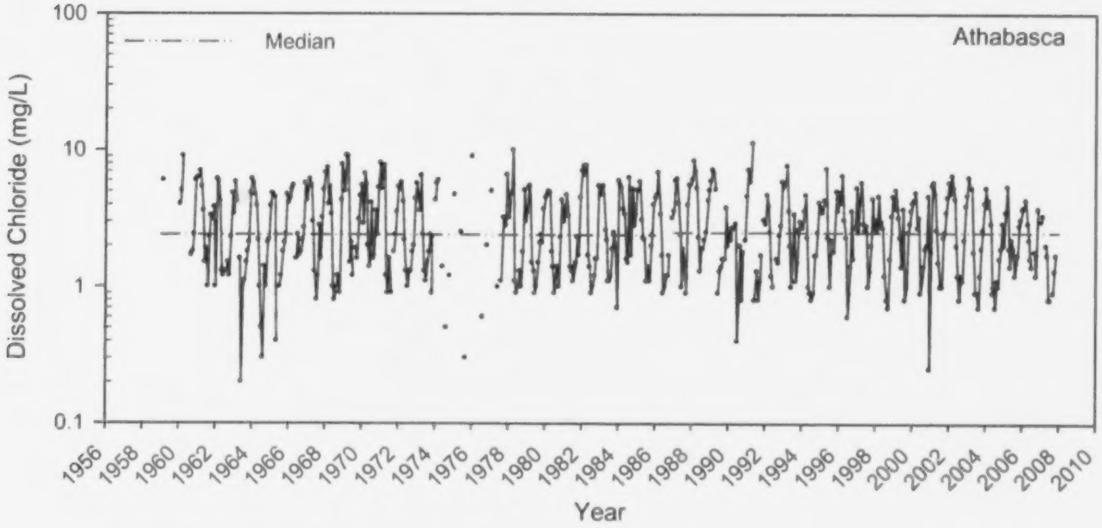


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.25		
Flow Adjusted								

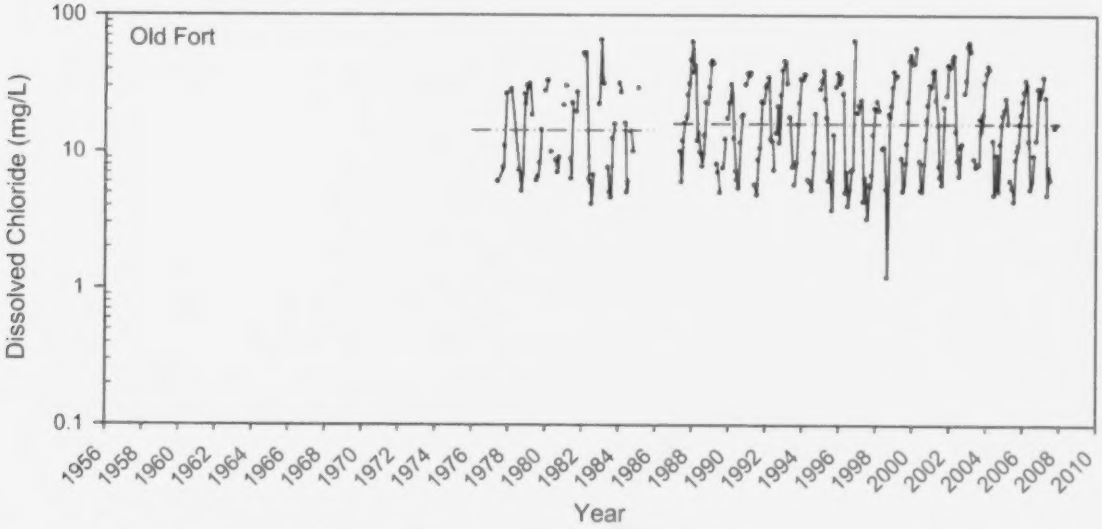


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.25		
Flow Adjusted								

Figure 75 Carbonate concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig.	Median	Slope	Sig
-0.0074	down	down	2.40	0.0000	NS	2.50	-0.0333	NS
Flow Adjusted								
-0.0138	down			0.0071	NS		-0.0416	down



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0000	NS	up	14.30	ID	ID	16.05	-0.0800	NS
Flow Adjusted								
-0.0897	down			ID	ID		-0.1546	down

Figure 76 Dissolved chloride concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

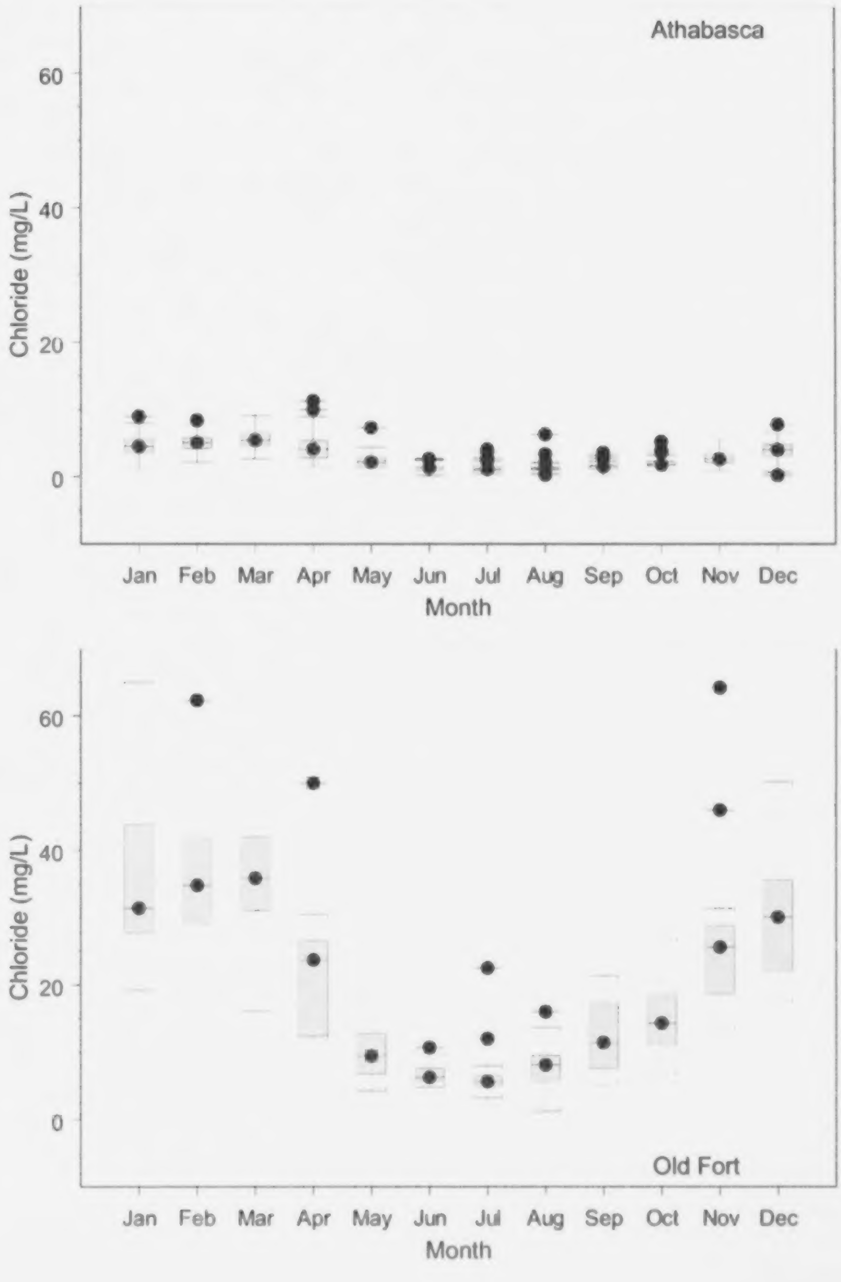
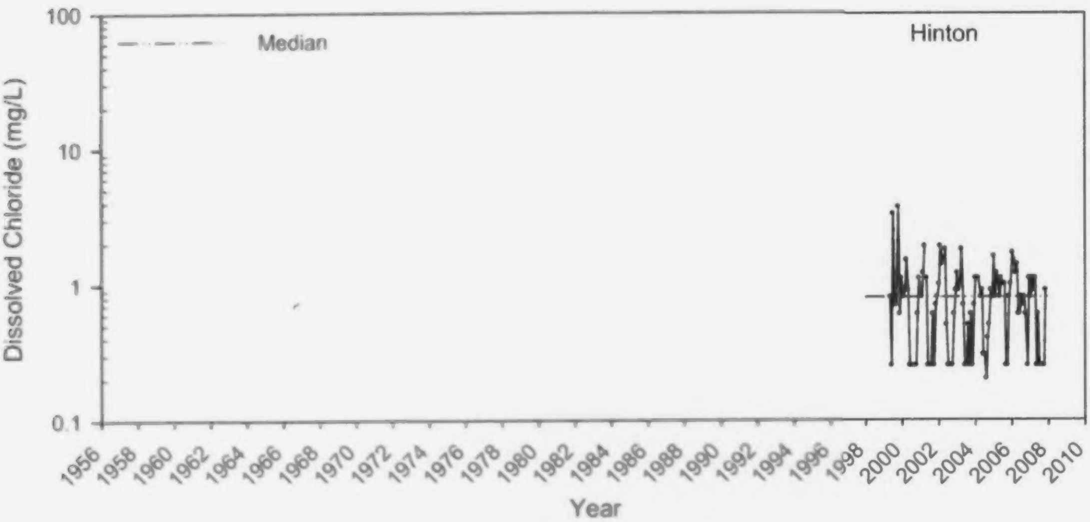
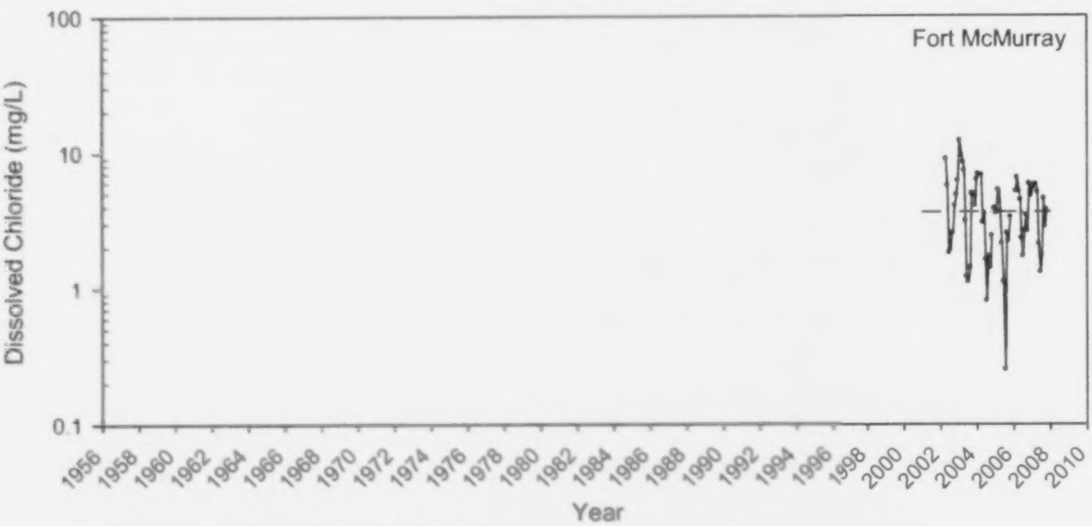


Figure 77 Seasonality of dissolved chloride in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.80		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						3.60		
Flow Adjusted								

Figure 78 Dissolved chloride concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

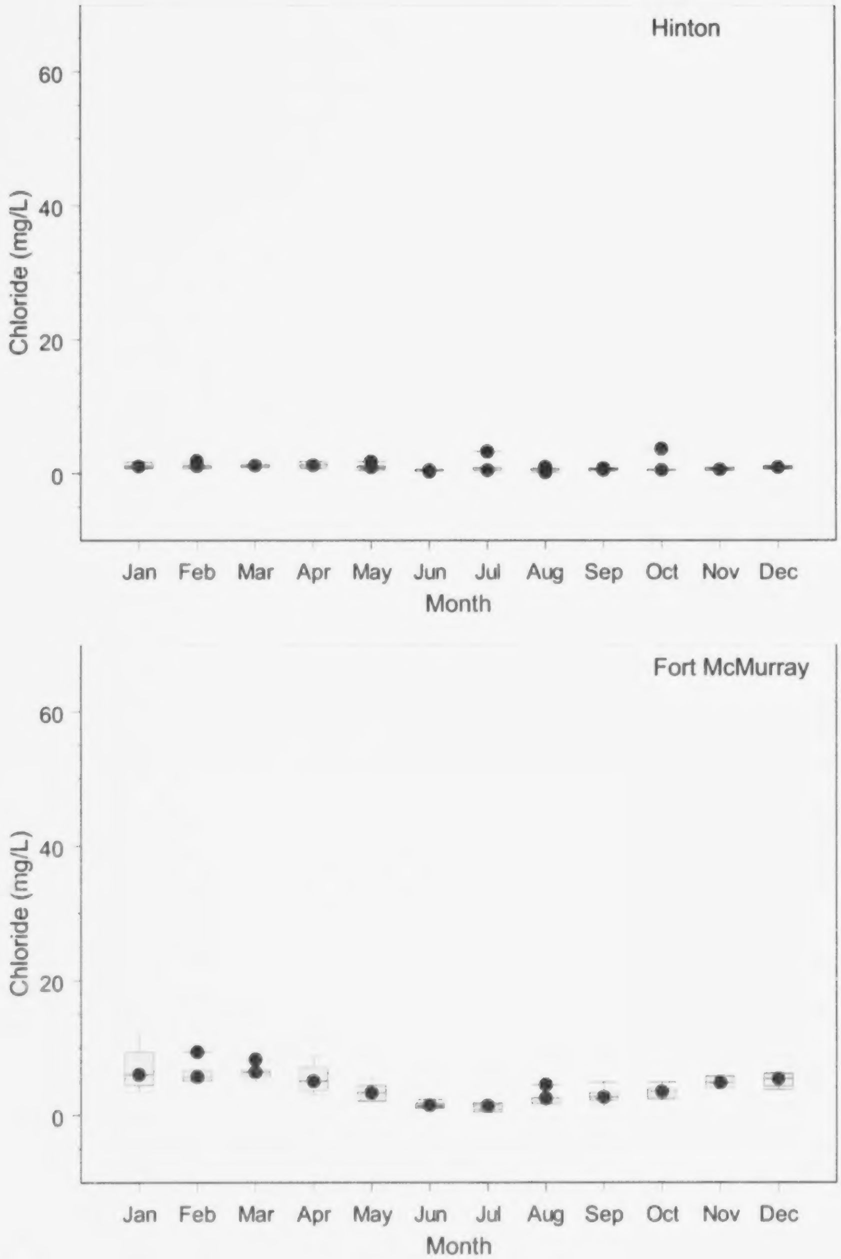
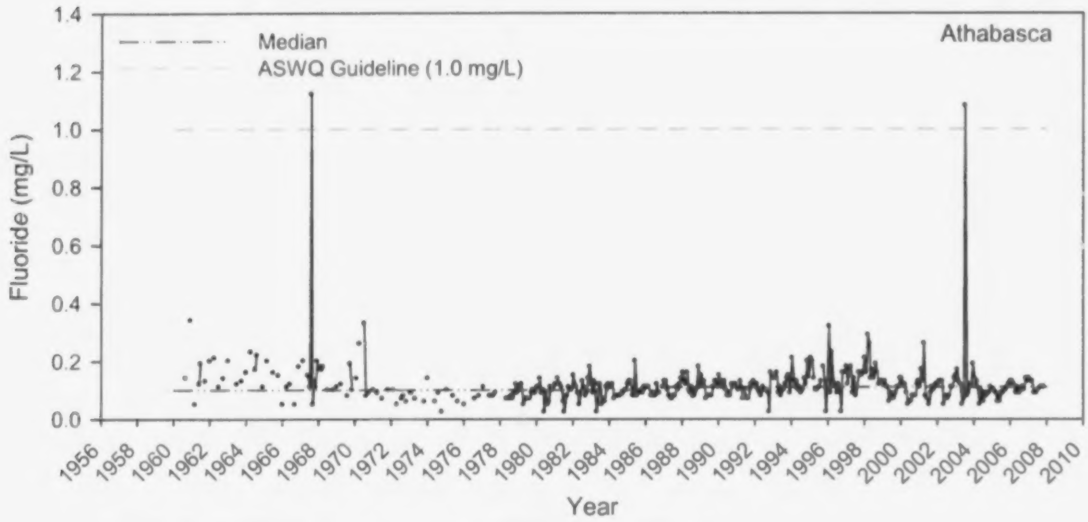
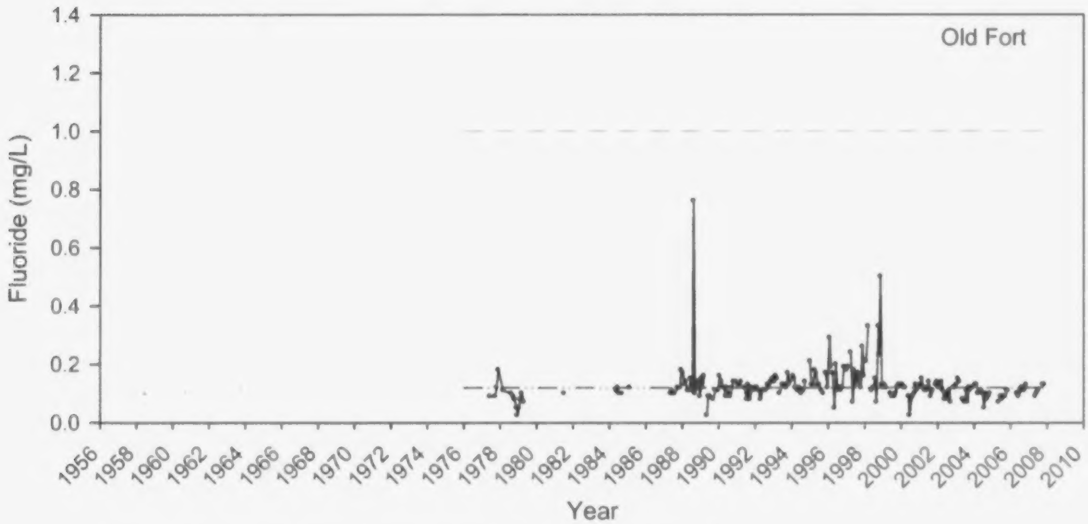


Figure 79 Seasonality of dissolved chloride in the Athabasca River at Hinton and Fort McMurray.

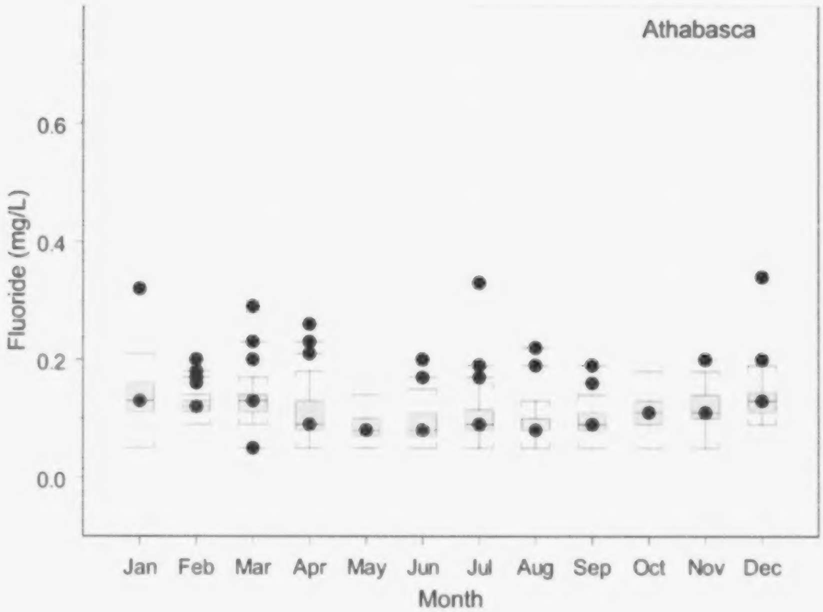


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
0.0005	up	up	0.10	ID	ID	0.11	0.0000	NS
Flow Adjusted								
0.0005	none			ID	ID		-0.0004	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
ID	ID	ID	0.10	ID	ID	0.12	-0.0022	NS
Flow Adjusted								
ID	ID			ID	ID		0.00	NS

Figure 80 Dissolved fluoride in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., p<0.05). ID = Insufficient Data, NS = Not Significant.



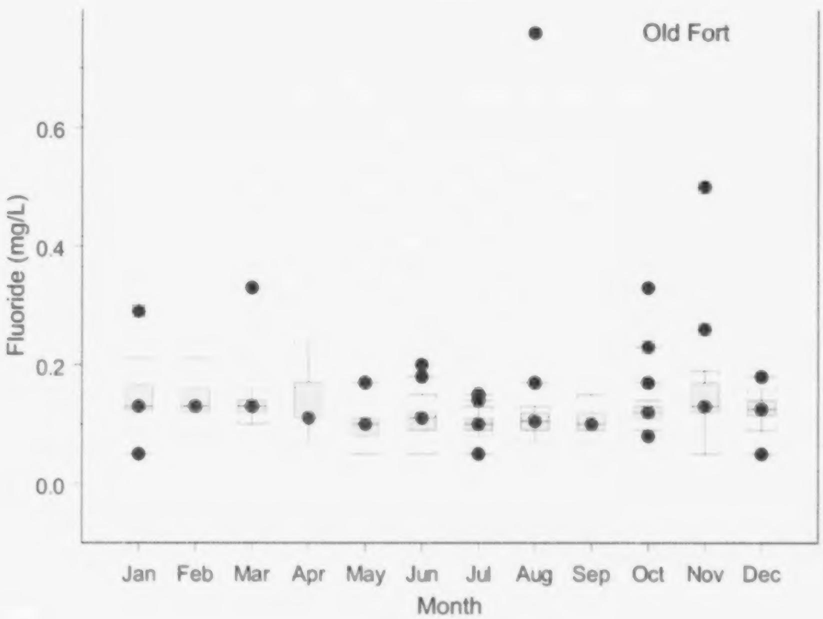
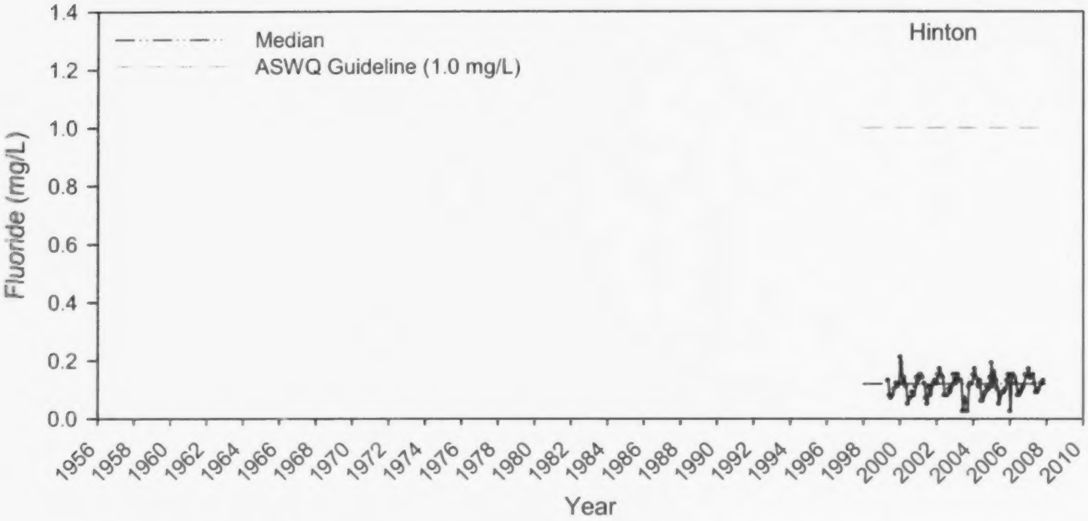
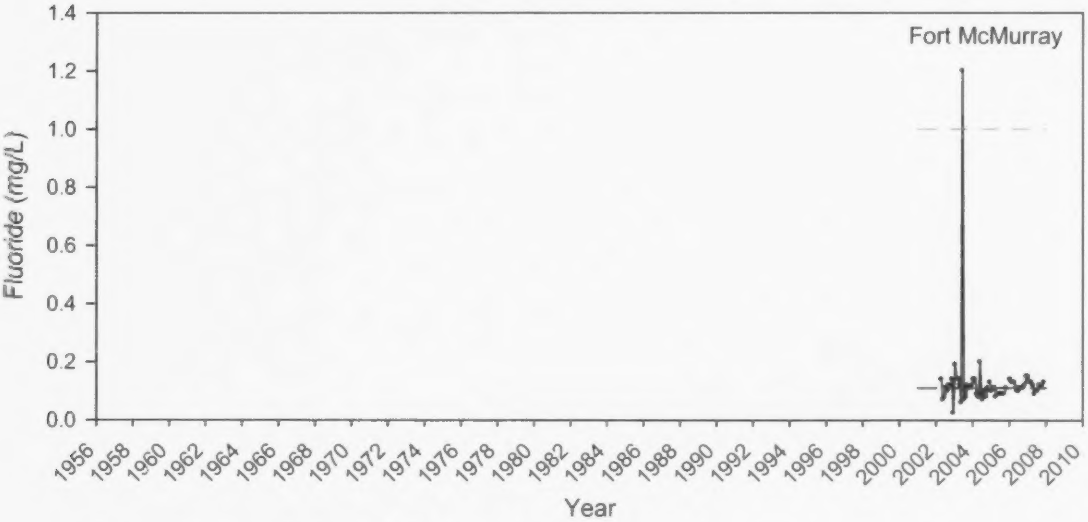


Figure 81 Seasonality of dissolved fluoride in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.12		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.11		
Flow Adjusted								

Figure 82 Dissolved fluoride concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

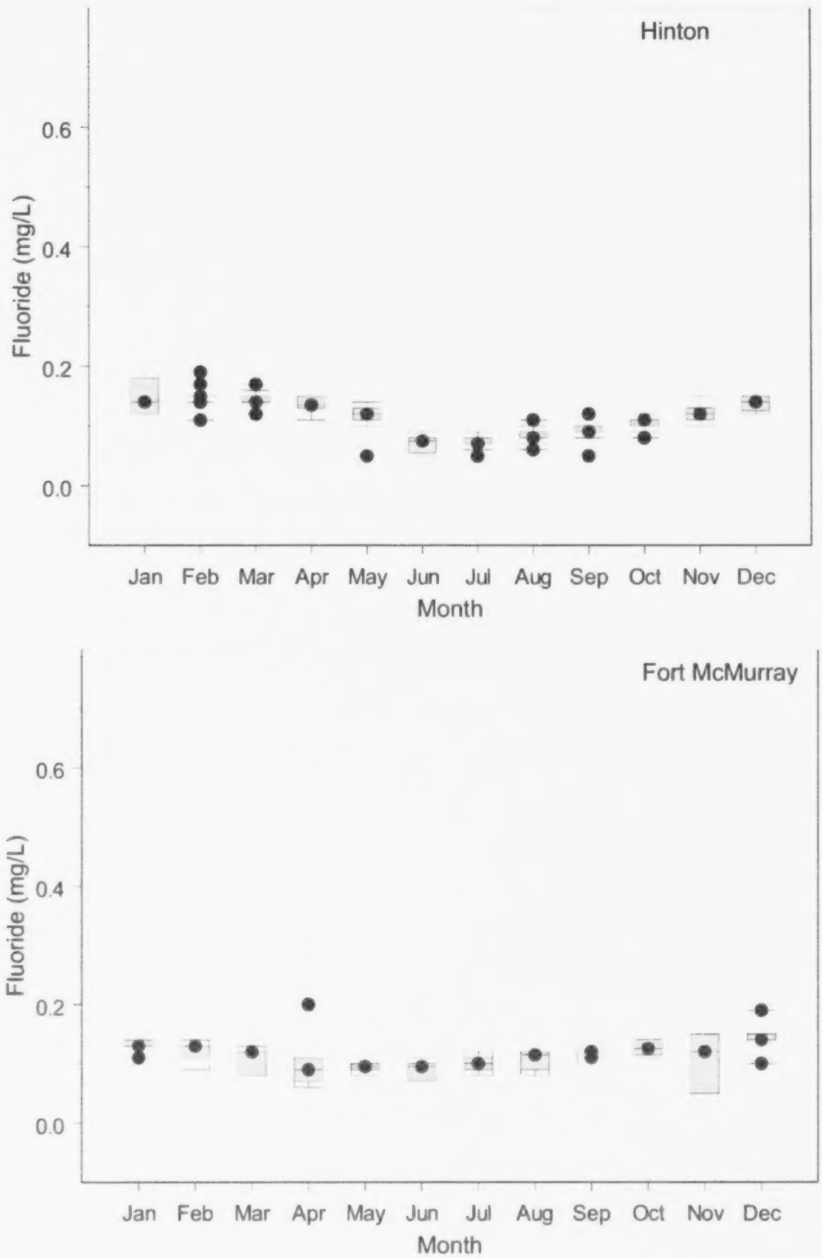
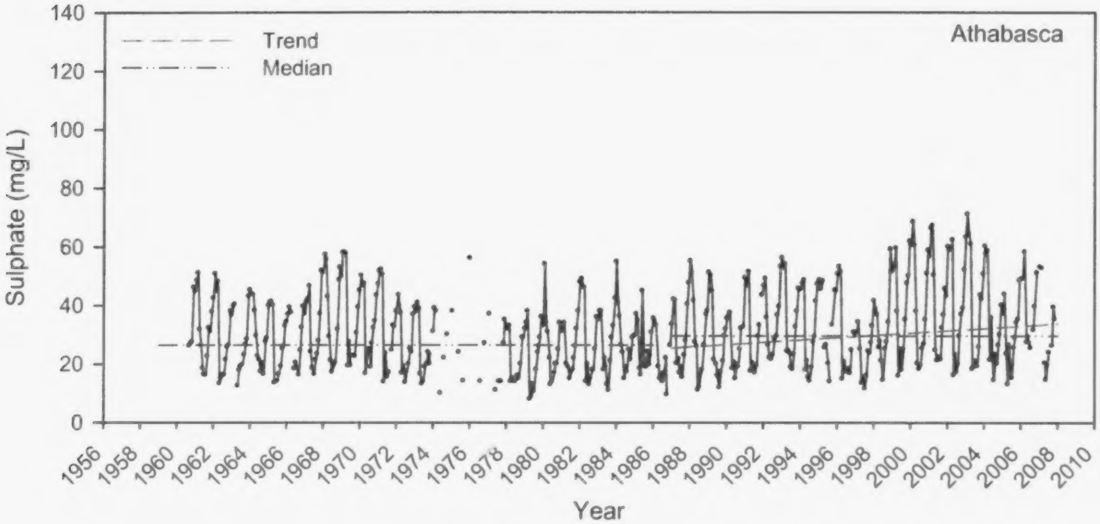
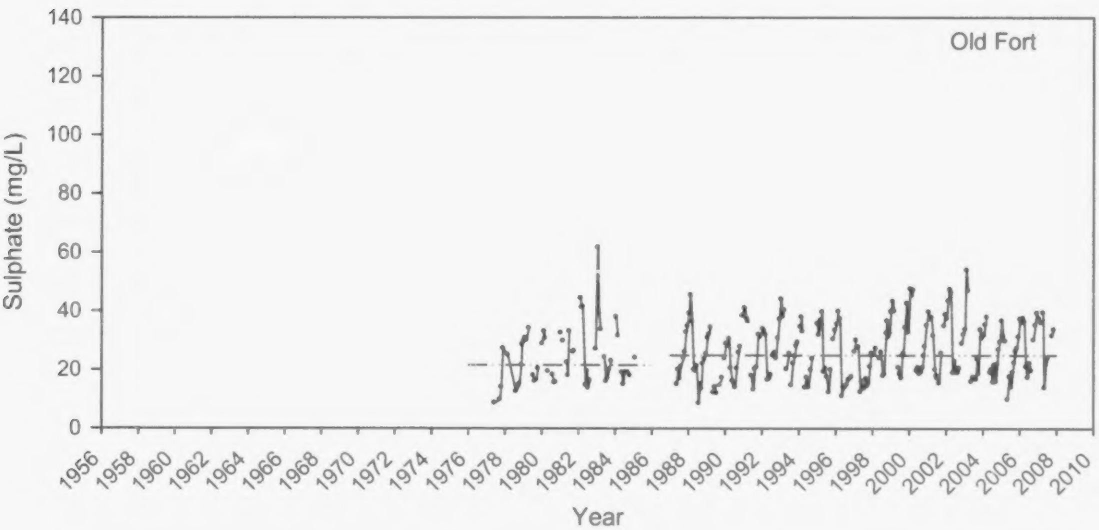


Figure 83 Seasonality of fluoride concentration in the Athabasca River at Hinton and Fort McMurray. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
0.1556	up	up	26.35	-0.1667	down	29.50	0.3923	up
Flow Adjusted								
0.1077	up			-0.1207	down		0.3534	up



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
0.1433	NS	up	21.50	ID	ID	24.90	0.1750	NS
Flow Adjusted								
0.0697	NS			ID	ID		0.1473	NS

Figure 84 Sulphate concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

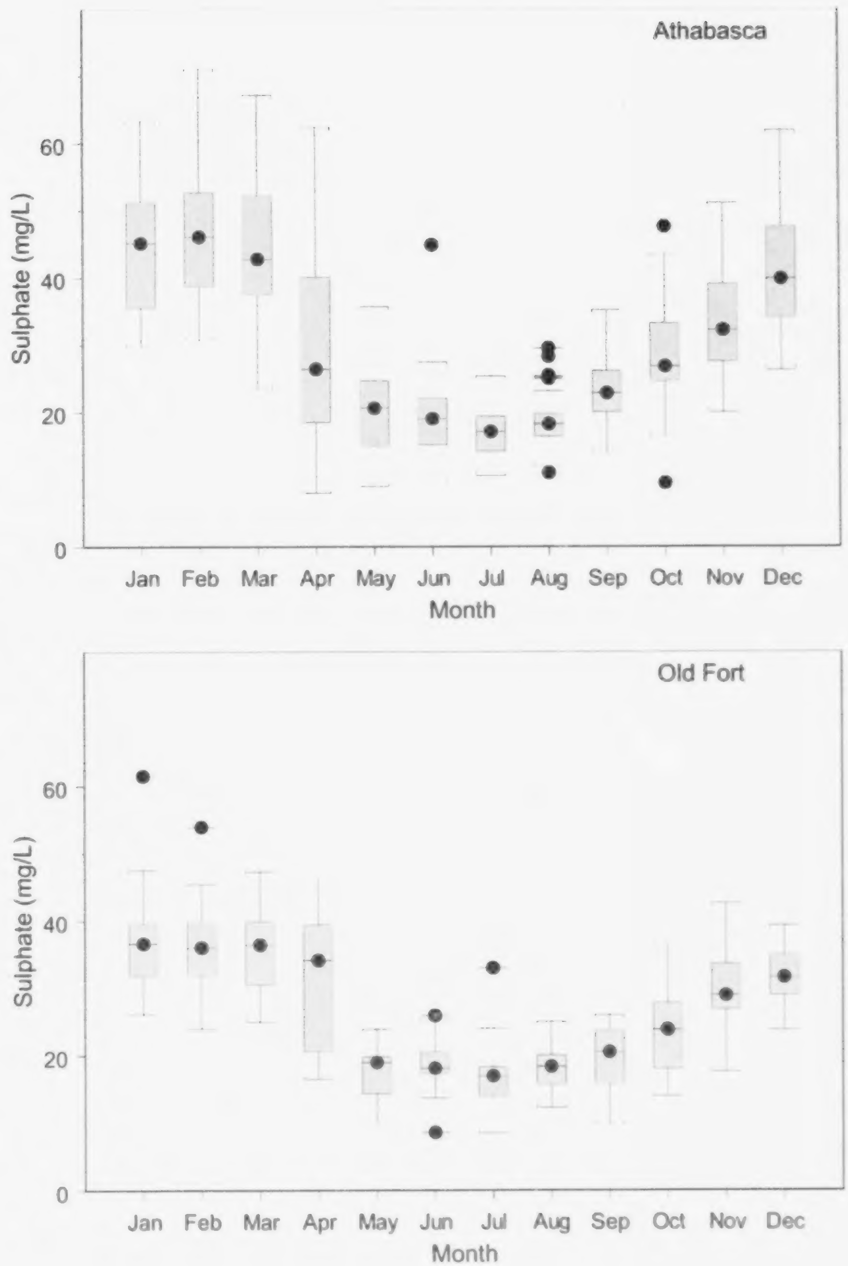
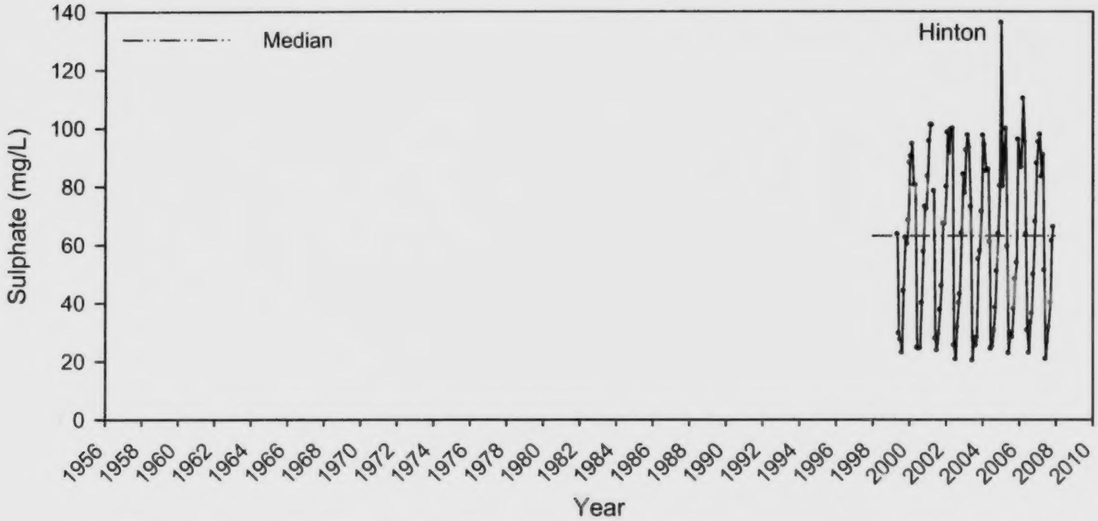
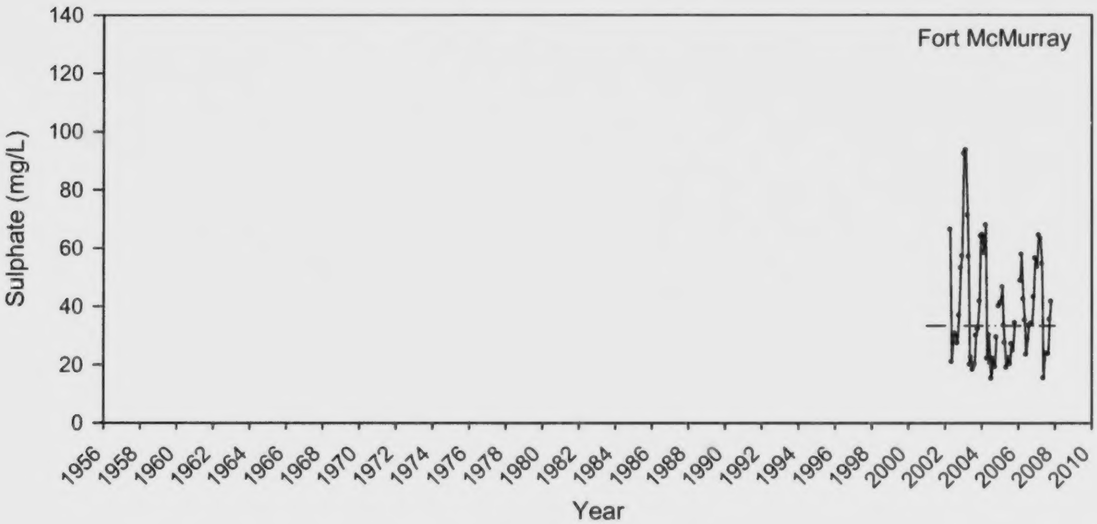


Figure 85 Seasonality of sulphate in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						63.00		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						33.30		
Flow Adjusted								

Figure 86 Sulphate concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

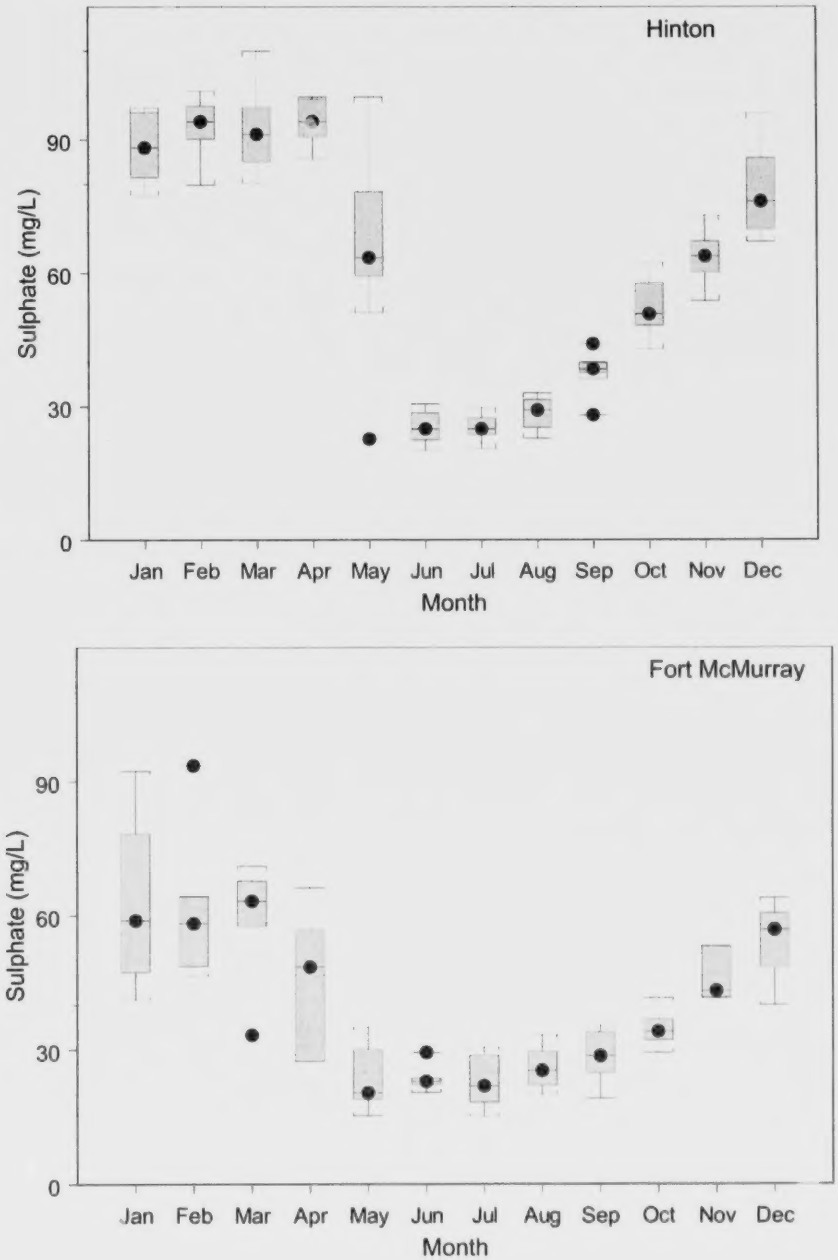
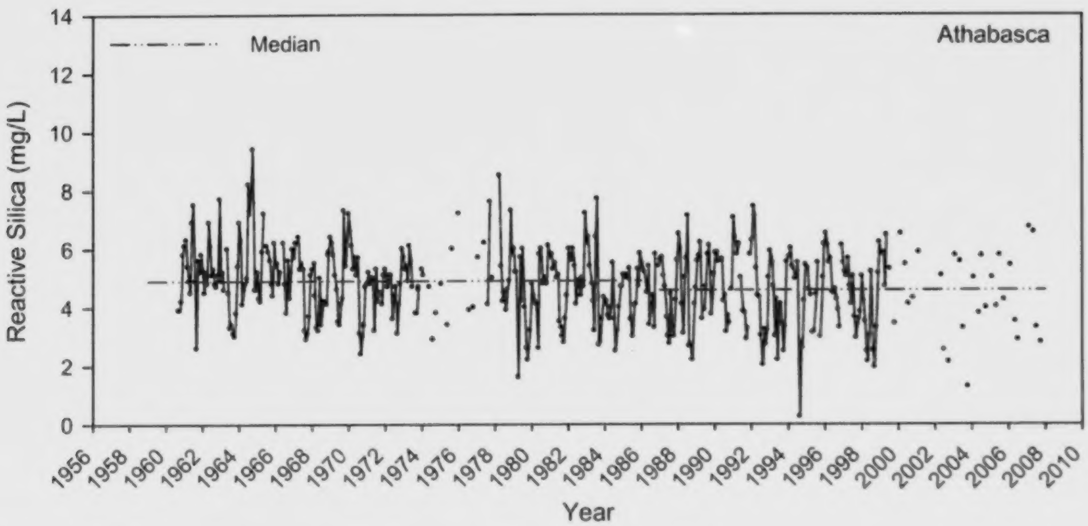
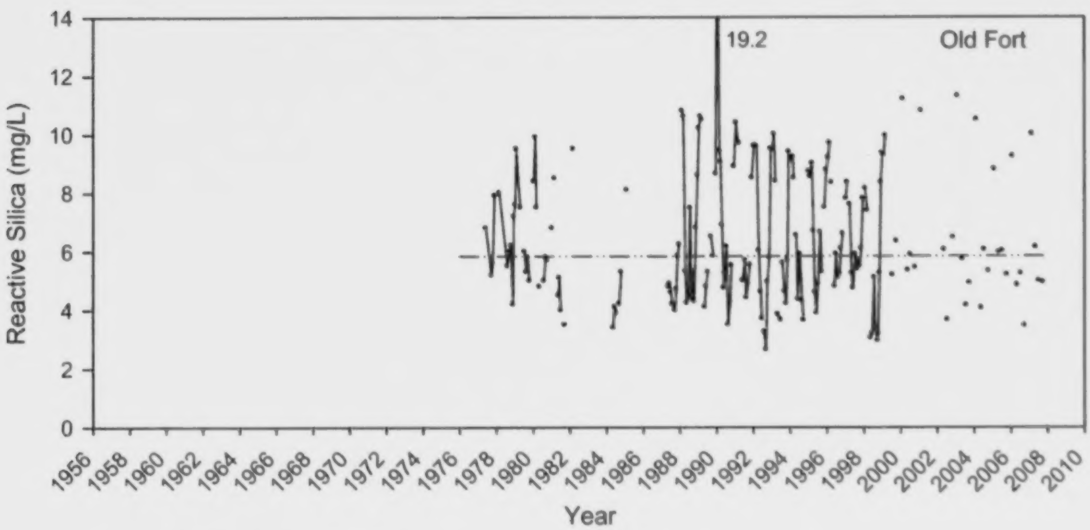


Figure 87 Seasonality of sulphate in the Athabasca River at Hinton and Fort McMurray. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
-0.0148	down	down	4.90	-0.0200	NS	4.58	-0.0143	NS
Flow Adjusted								
-0.0141	NS			-0.0171	NS		0.0008	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0246	NS	NS	5.80	ID	ID	5.84	-0.1687	NS
Flow Adjusted								
-0.0160	NS			ID	ID		-0.1076	NS

Figure 88 Reactive silica concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

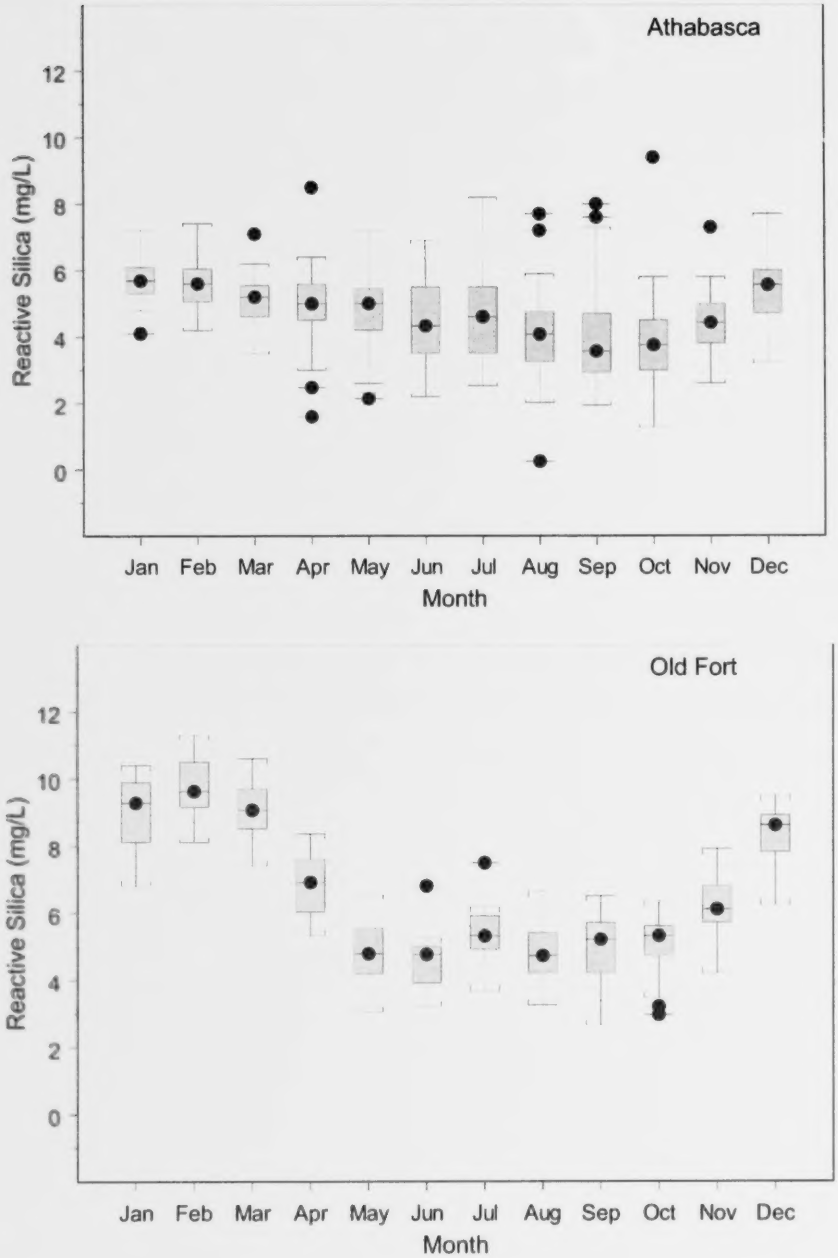
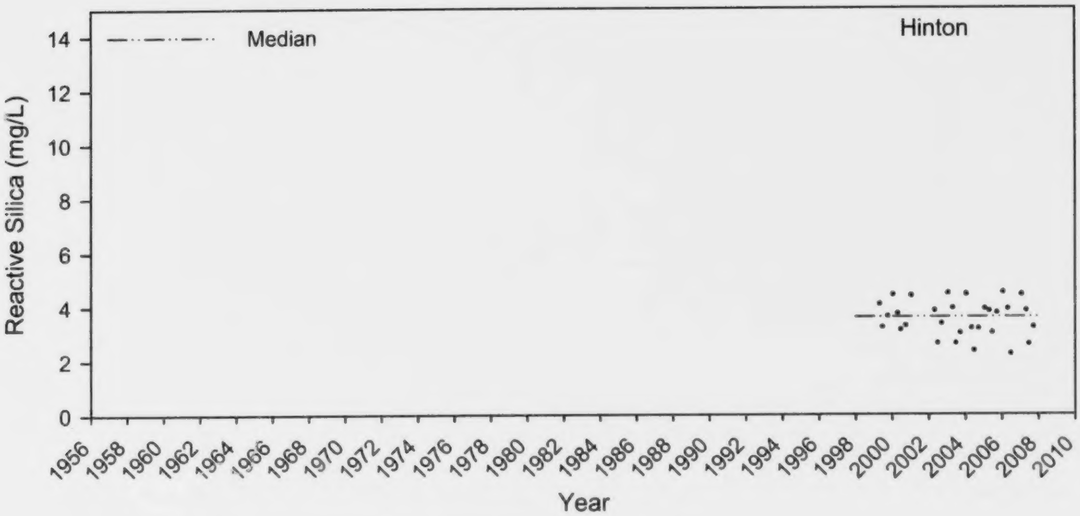
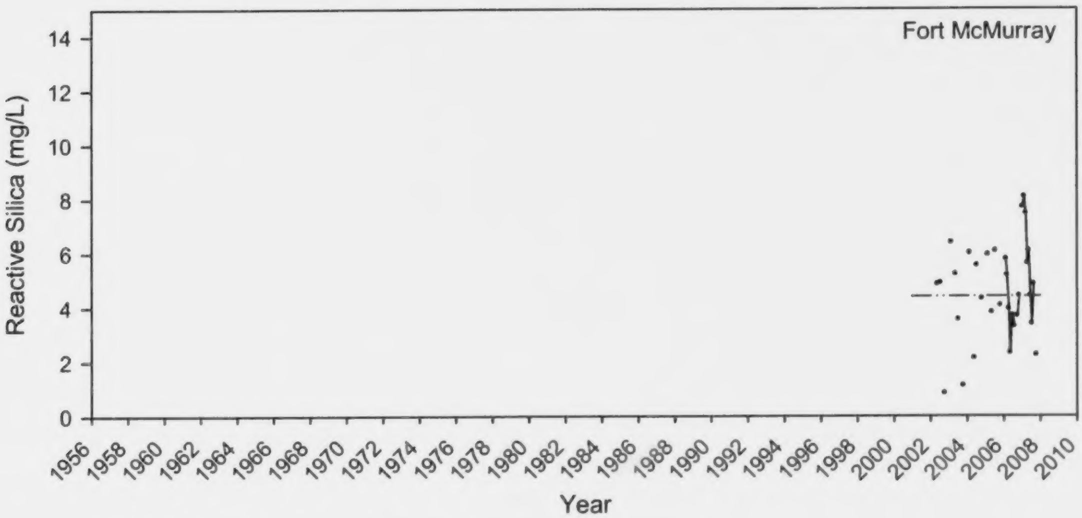


Figure 89 Seasonality of reactive silica in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						3.60		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						4.39		
Flow Adjusted								

Figure 90 Reactive silica concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

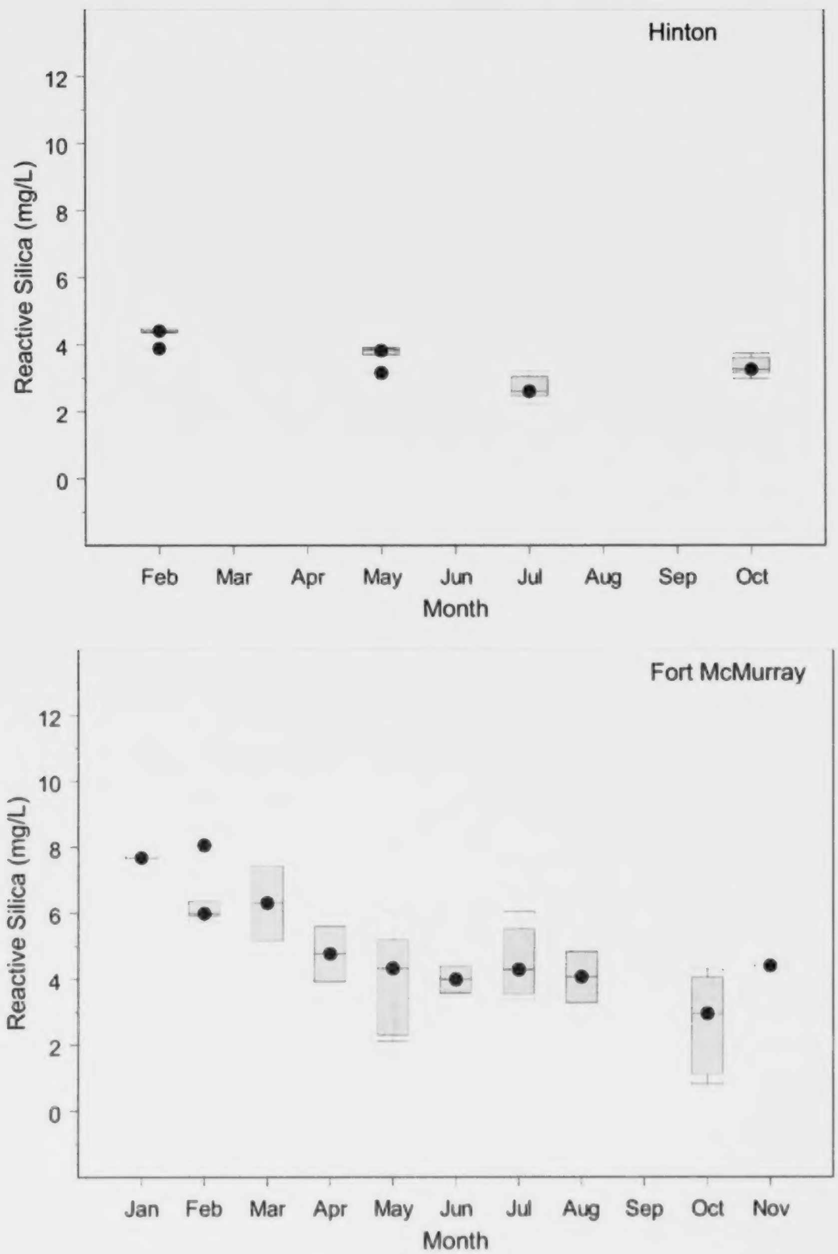
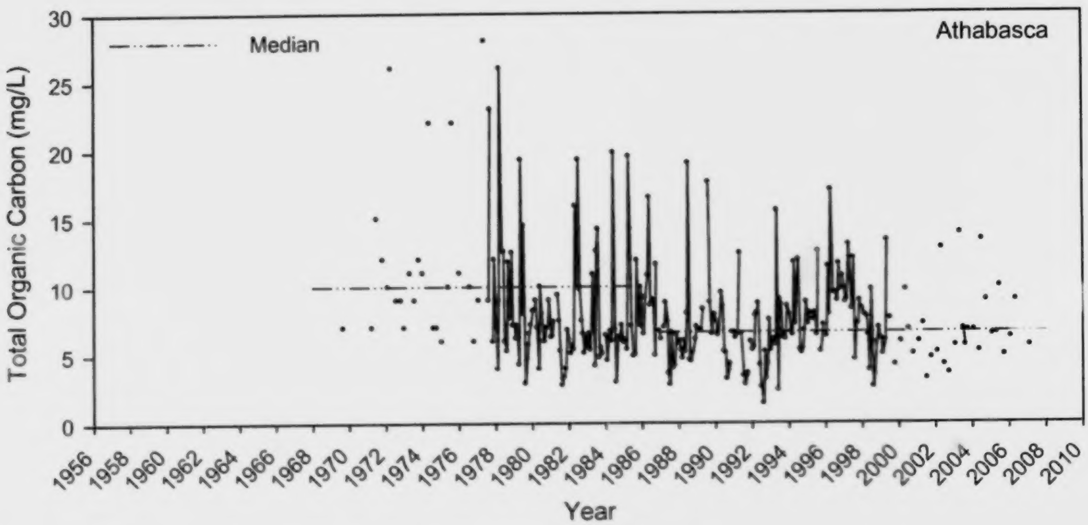
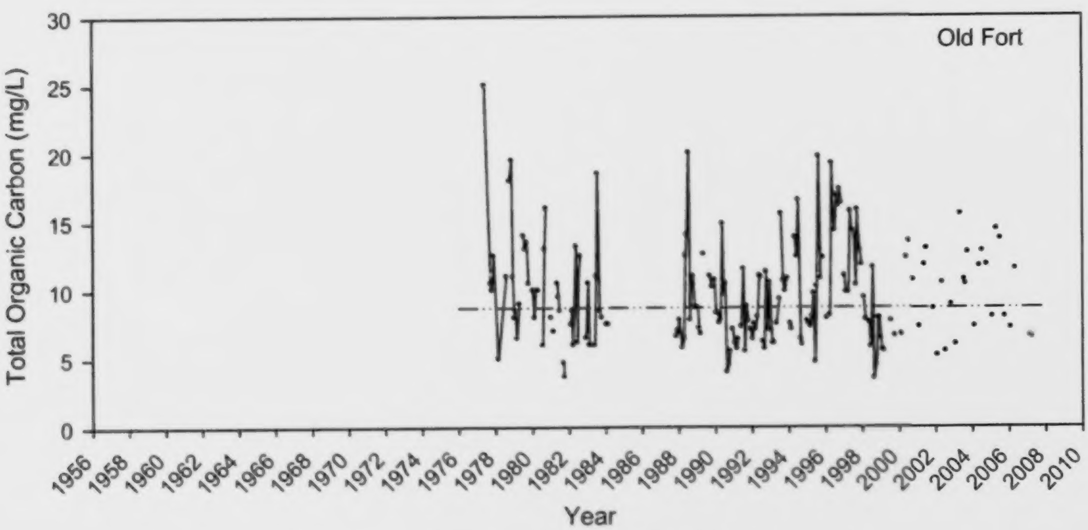


Figure 91 Seasonality of reactive silica in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987			Post-1987		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
-0.0222	NS	down	10.00	0.2000	NS	6.65	0.2000	NS
Flow Adjusted								
0.0166	NS			0.0403	NS		0.0231	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0500	NS	NS	9.75	ID	ID	7.80	0.2000	NS
Flow Adjusted								
0.0328	NS			ID	ID		0.2086	NS

Figure 92 Total organic carbon concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., p<0.05). ID = Insufficient Data, NS = Not Significant.

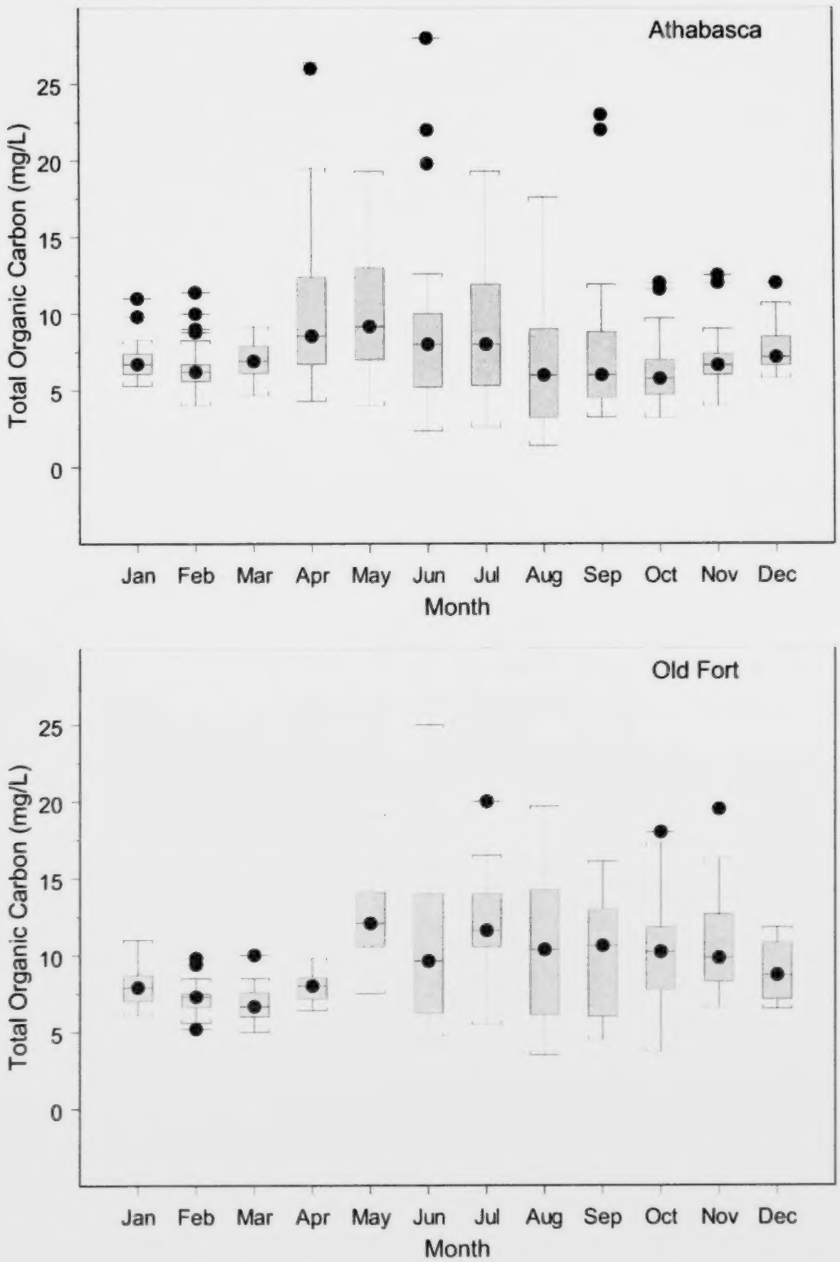
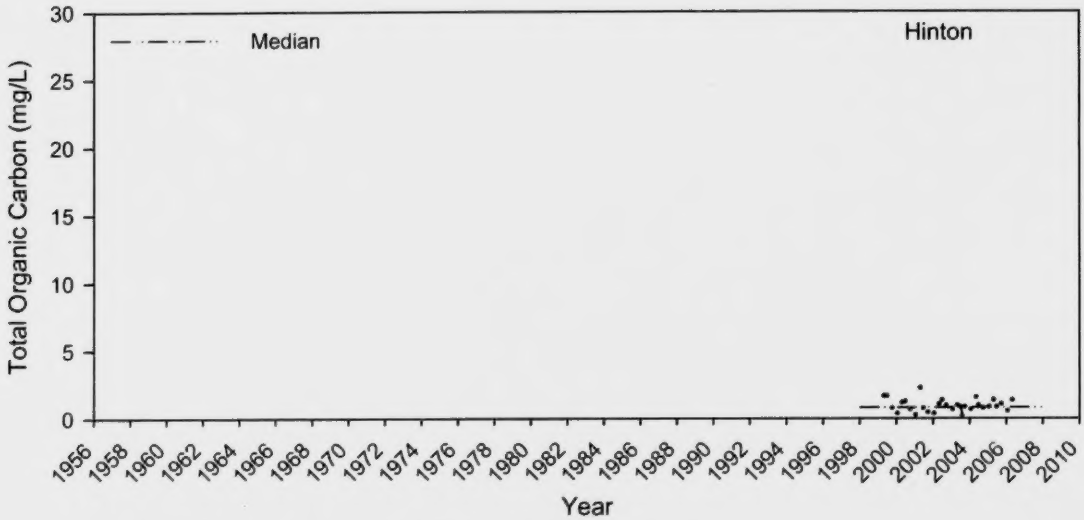
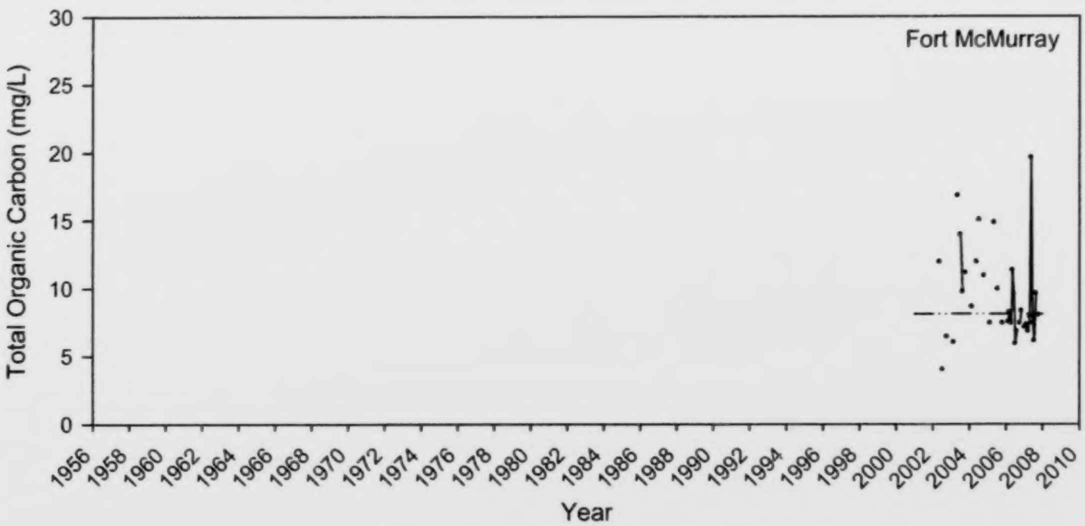


Figure 93 Seasonality of total organic carbon at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.80		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						8.10		
Flow Adjusted								

Figure 94 Total organic carbon concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.

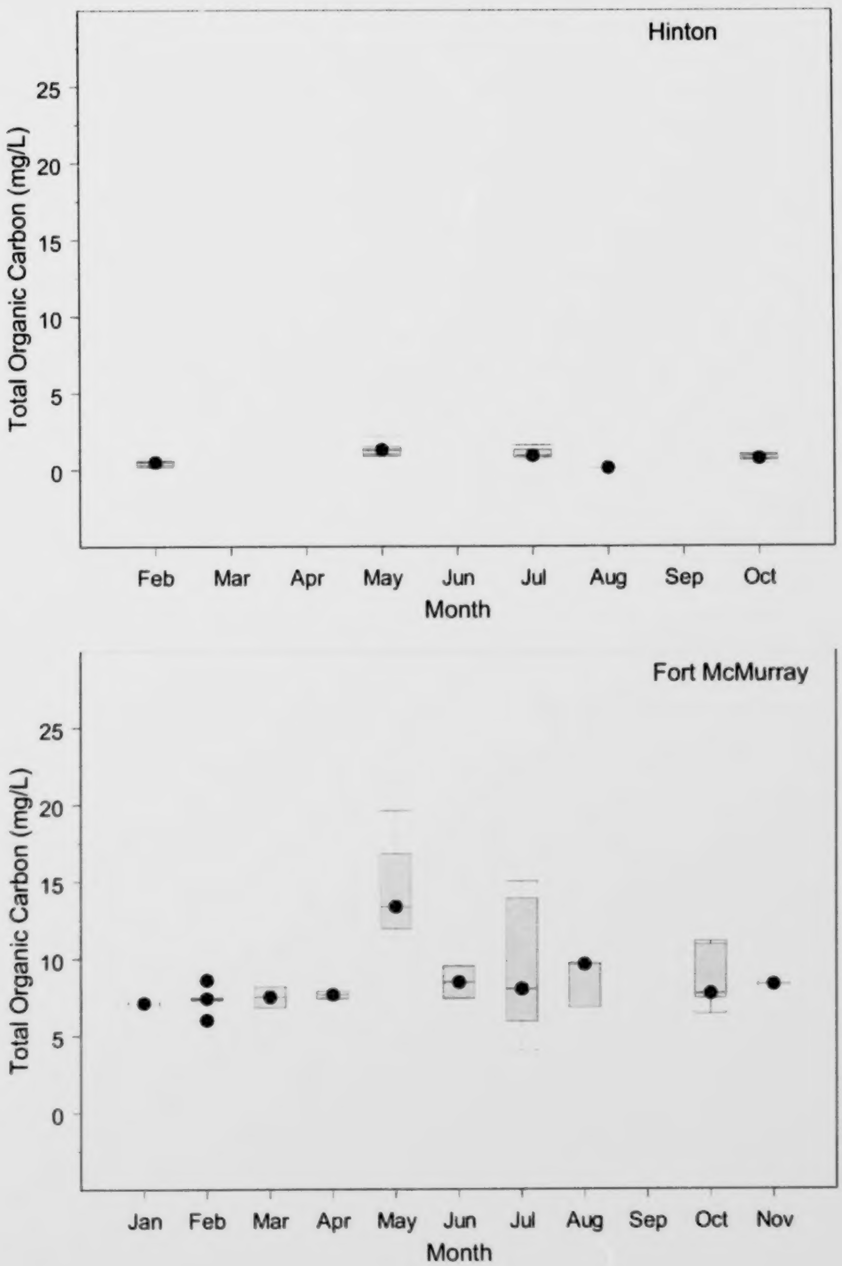
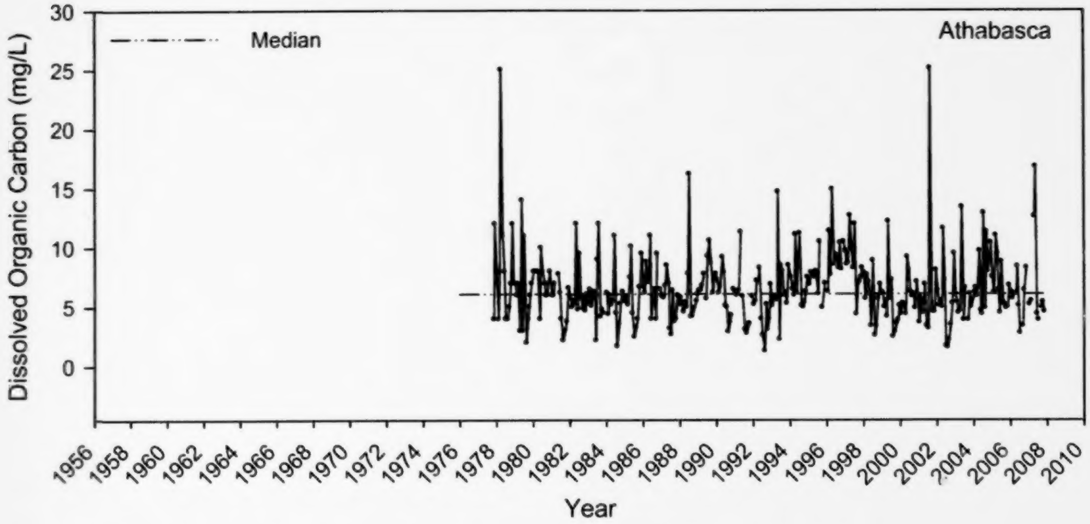
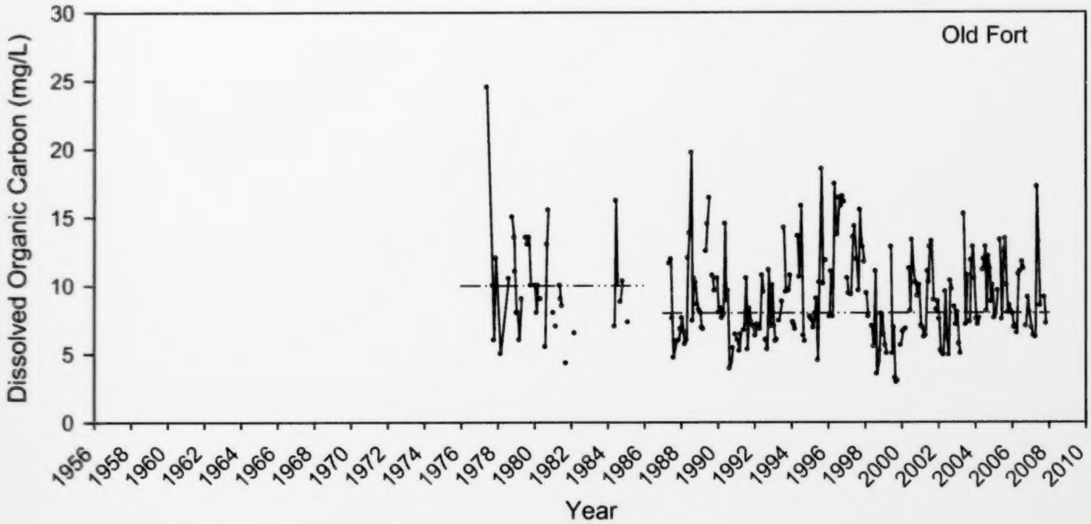


Figure 95 Seasonality of total organic carbon in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0000	NS	NS	6.00	-0.1000	NS	6.10	0.0000	NS
Flow Adjusted								
0.0057	NS			-0.0771	NS		-0.0033	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	down	10.00	ID	ID	8.00	0.0000	NS
Flow Adjusted								
ID	ID			ID	ID		0.0201	NS

Figure 96 Dissolved organic carbon in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

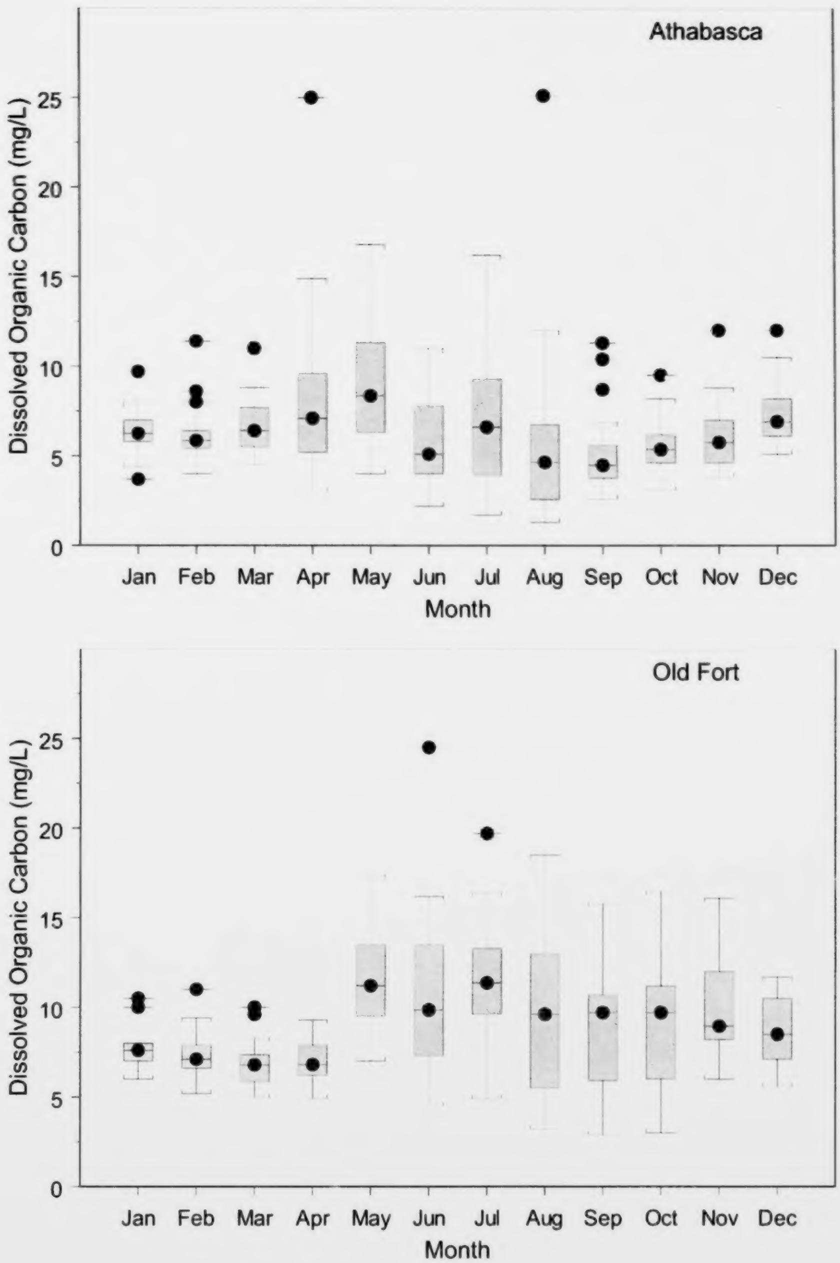
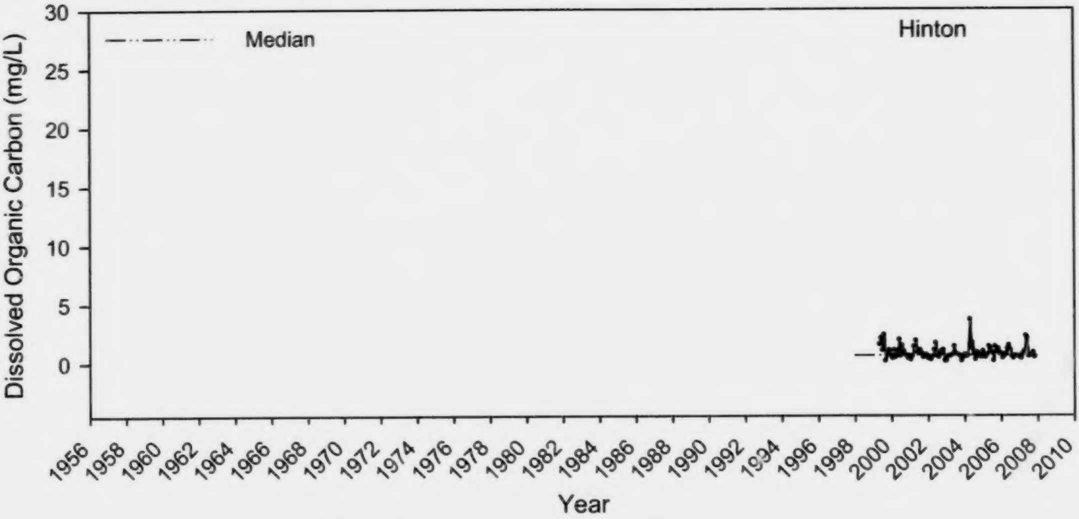
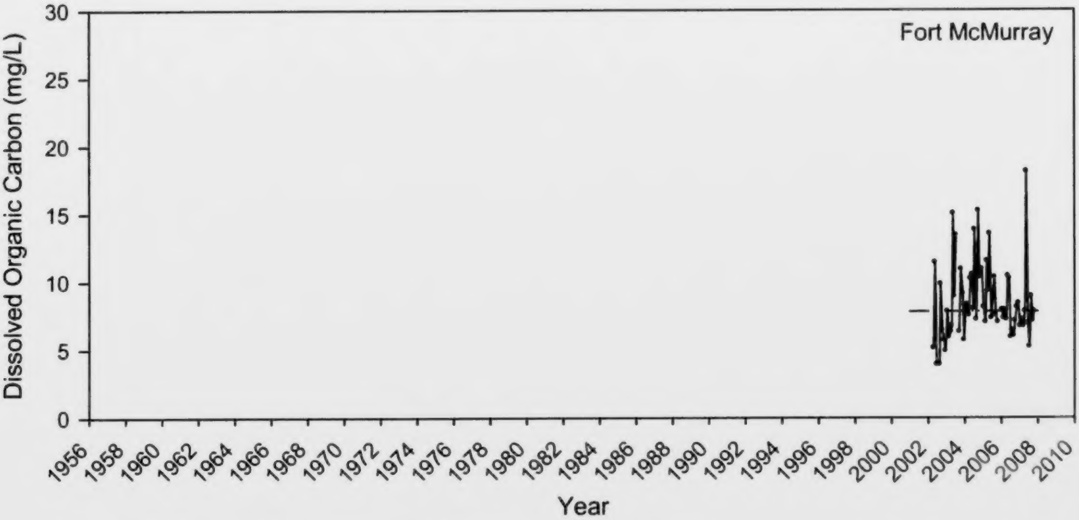


Figure 97 Seasonality of dissolved organic carbon in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.60		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						7.80		
Flow Adjusted								

Figure 98 Dissolved organic carbon in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

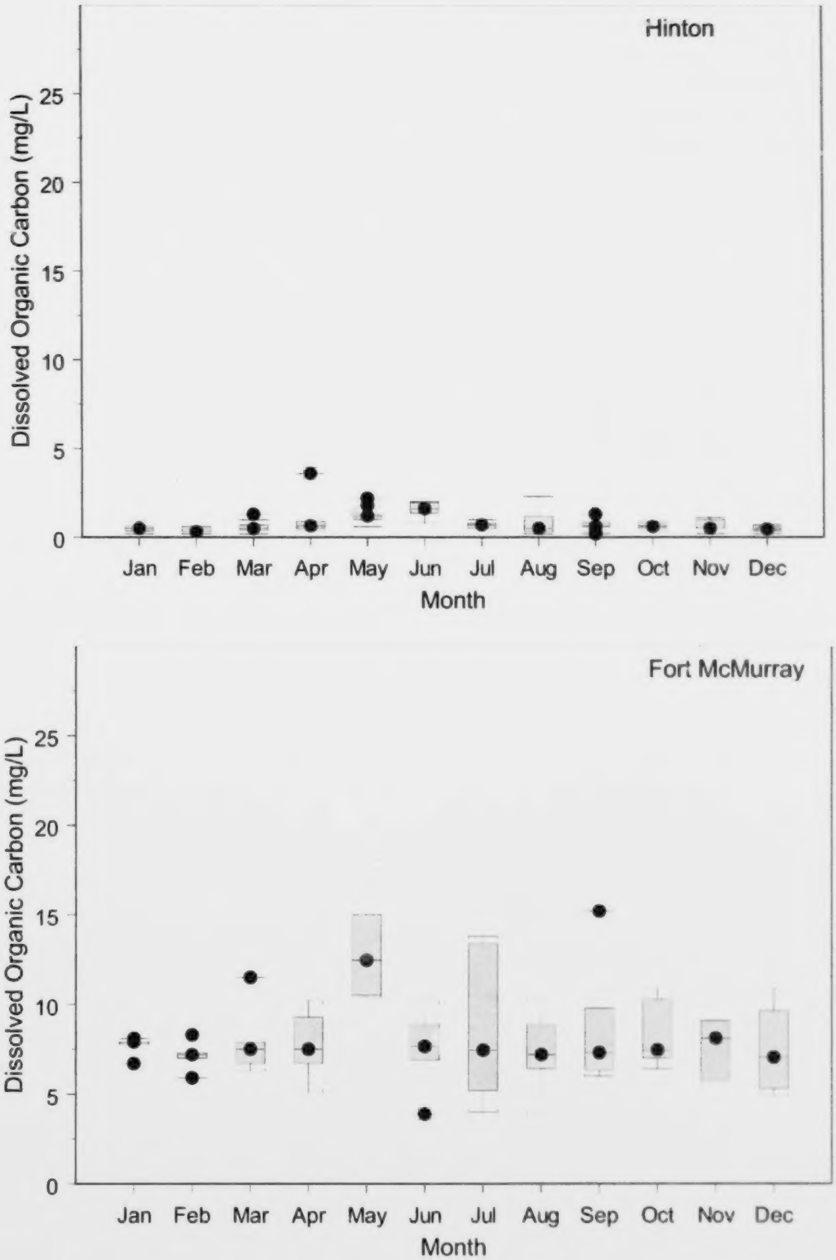
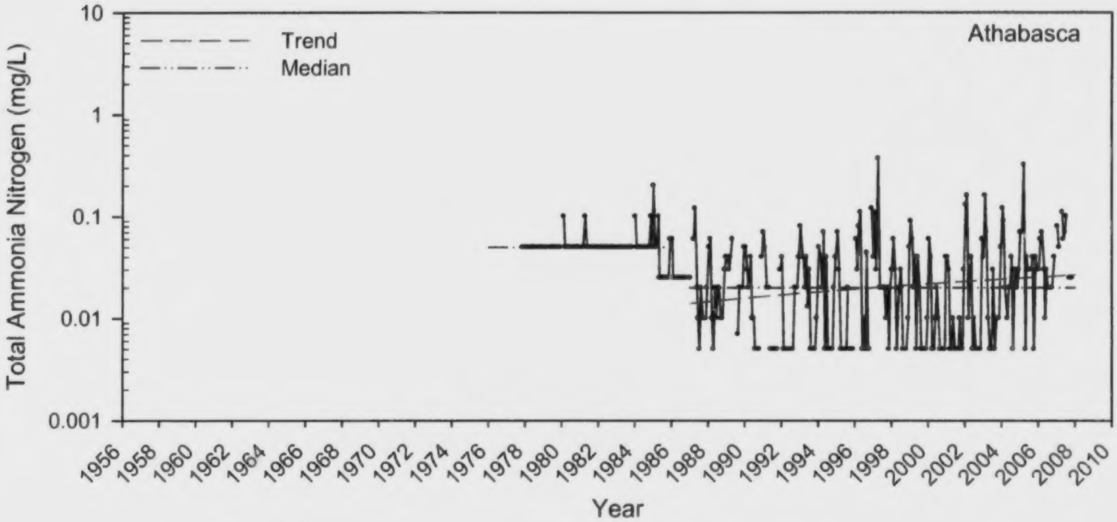
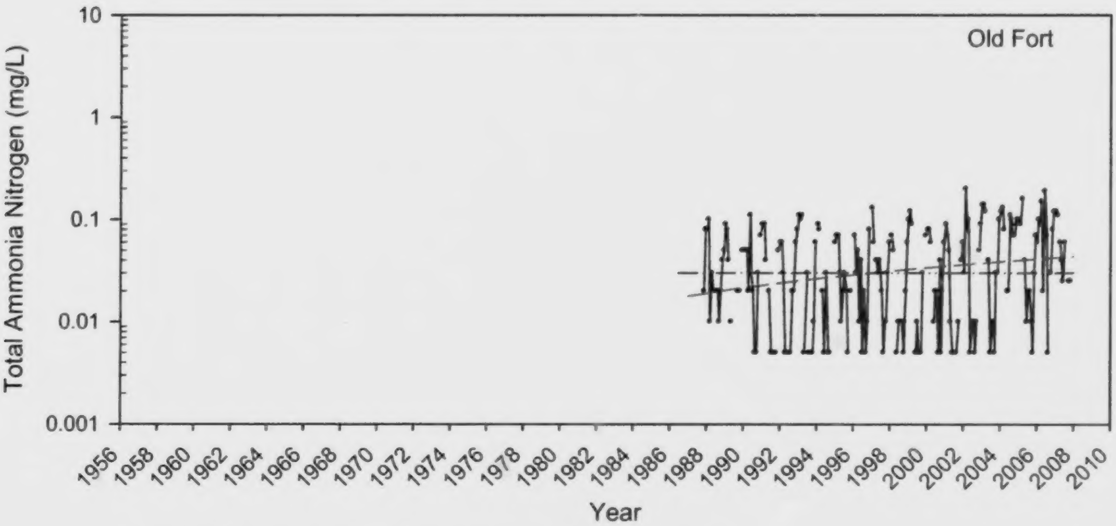


Figure 99 Seasonality of dissolved organic carbon in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	down	0.05	ID	ID	0.02	3.0007%	up
Flow Adjusted								
ID	ID			ID	ID		0.0000	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	ID	ID	ID	ID	0.03	4.0676%	up
Flow Adjusted								
ID	ID			ID	ID		0.0005	NS

Figure 100 Total ammonia nitrogen concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., p<0.05). ID = Insufficient Data, NS = Not Significant.

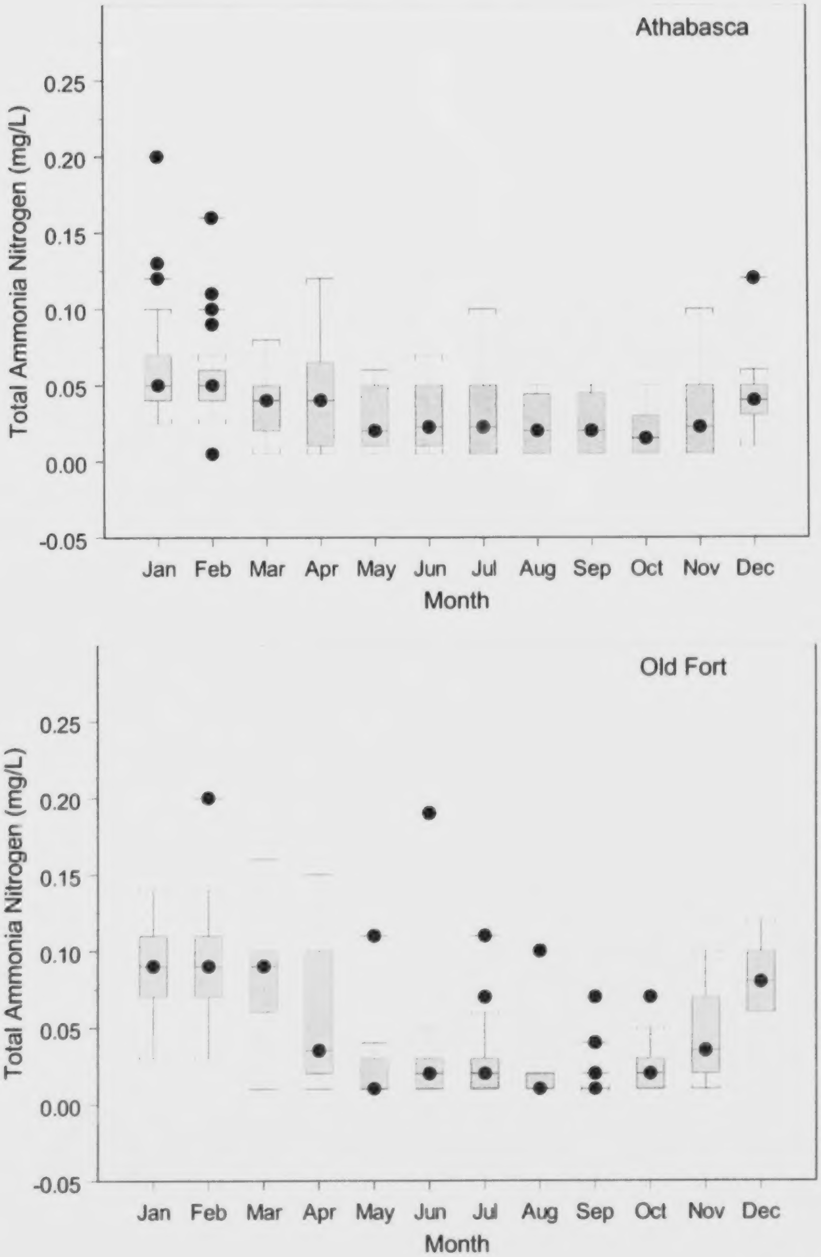
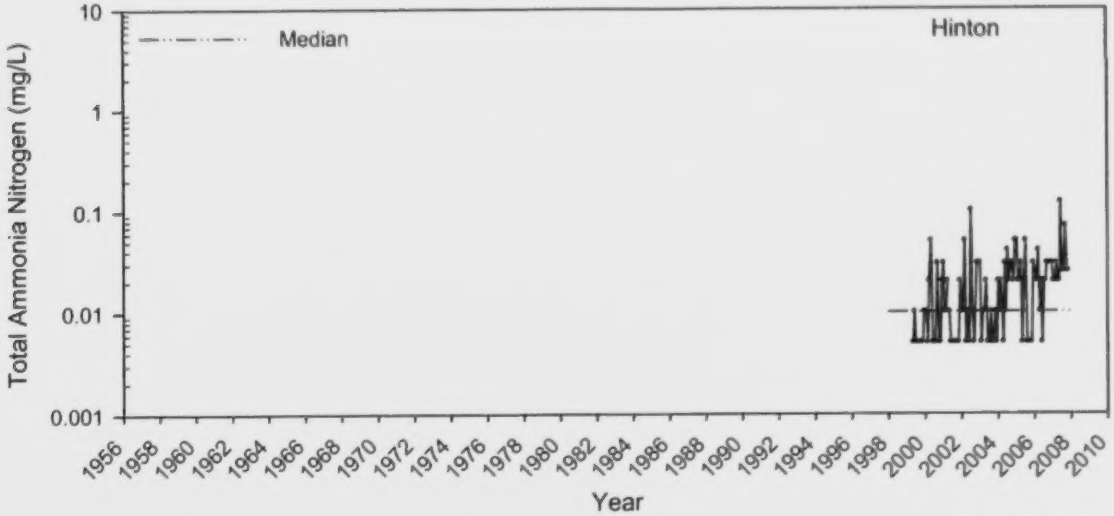
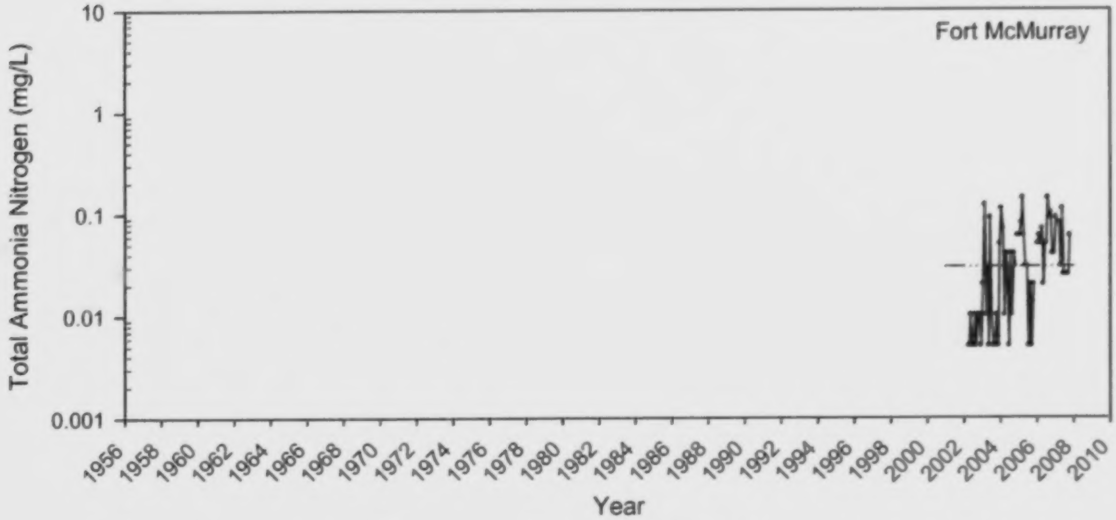


Figure 101 Seasonality of total ammonia nitrogen in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.01		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.03		
Flow Adjusted								

Figure 102 Total ammonia nitrogen concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

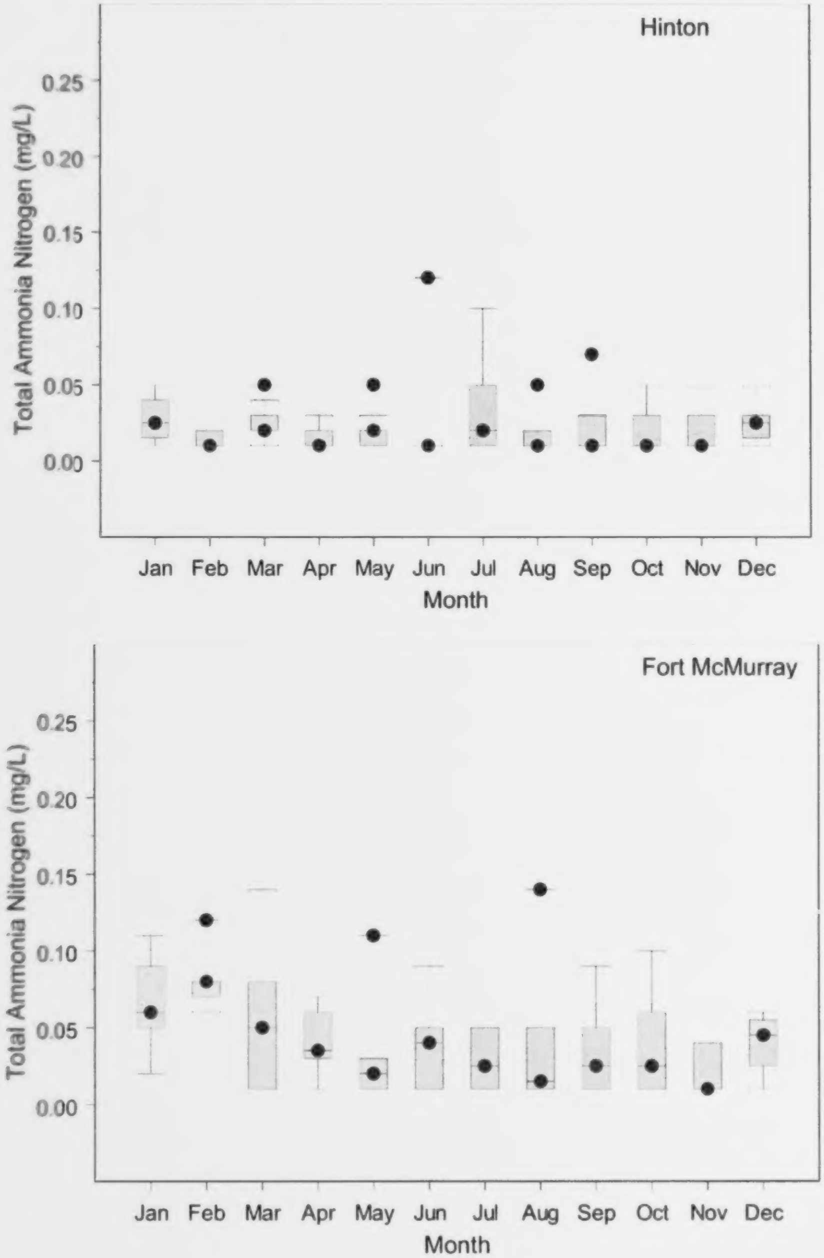
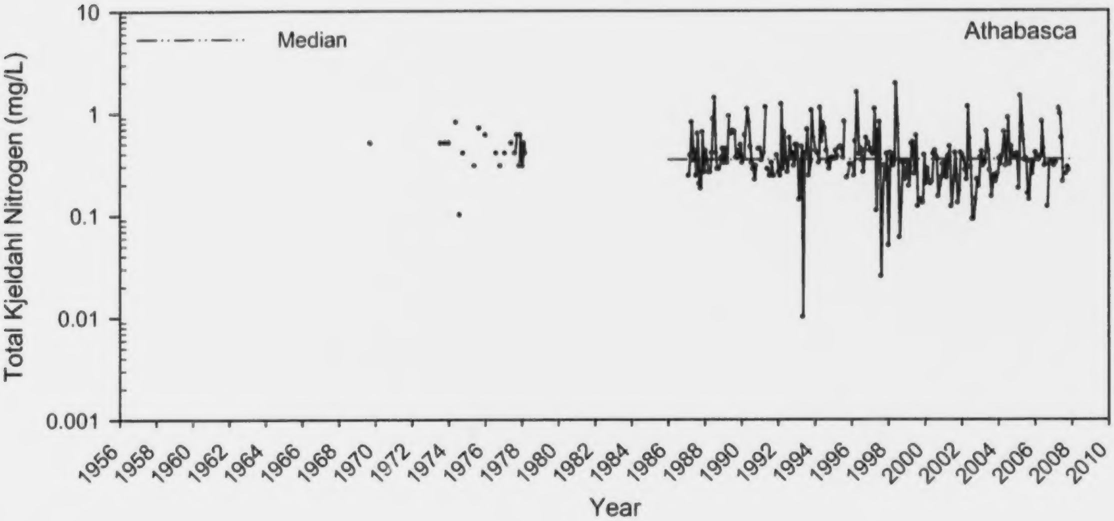
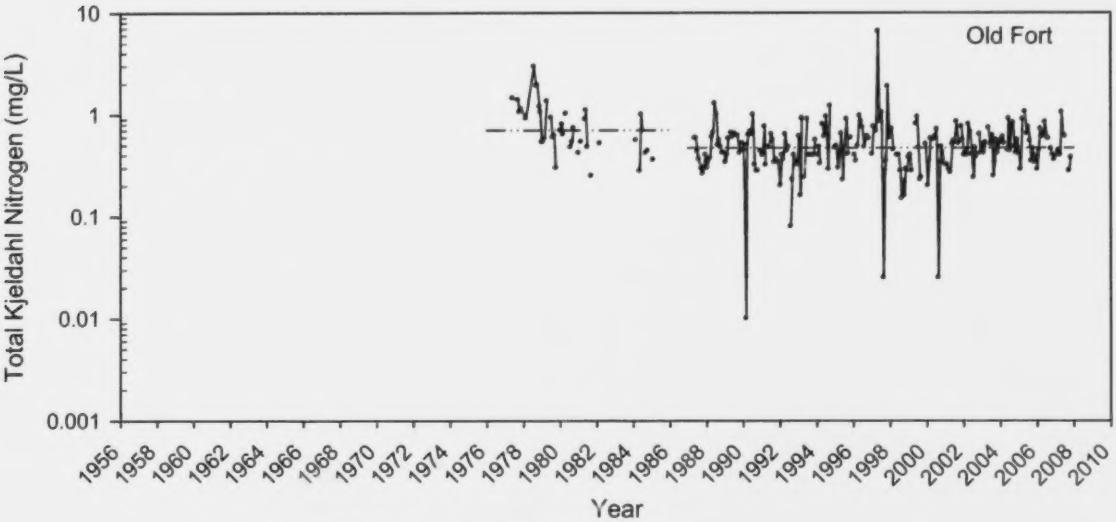


Figure 103 Seasonality of total ammonia nitrogen in the Athabasca River at Hinton and Fort McMurray.





Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	down	0.70	ID	ID	0.46	0.0007	NS
Flow Adjusted								
ID	ID			ID	ID		0.0026	NS

Figure 104 Total Kjeldahl nitrogen concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., p<0.05). ID = Insufficient Data, NS = Not Significant.

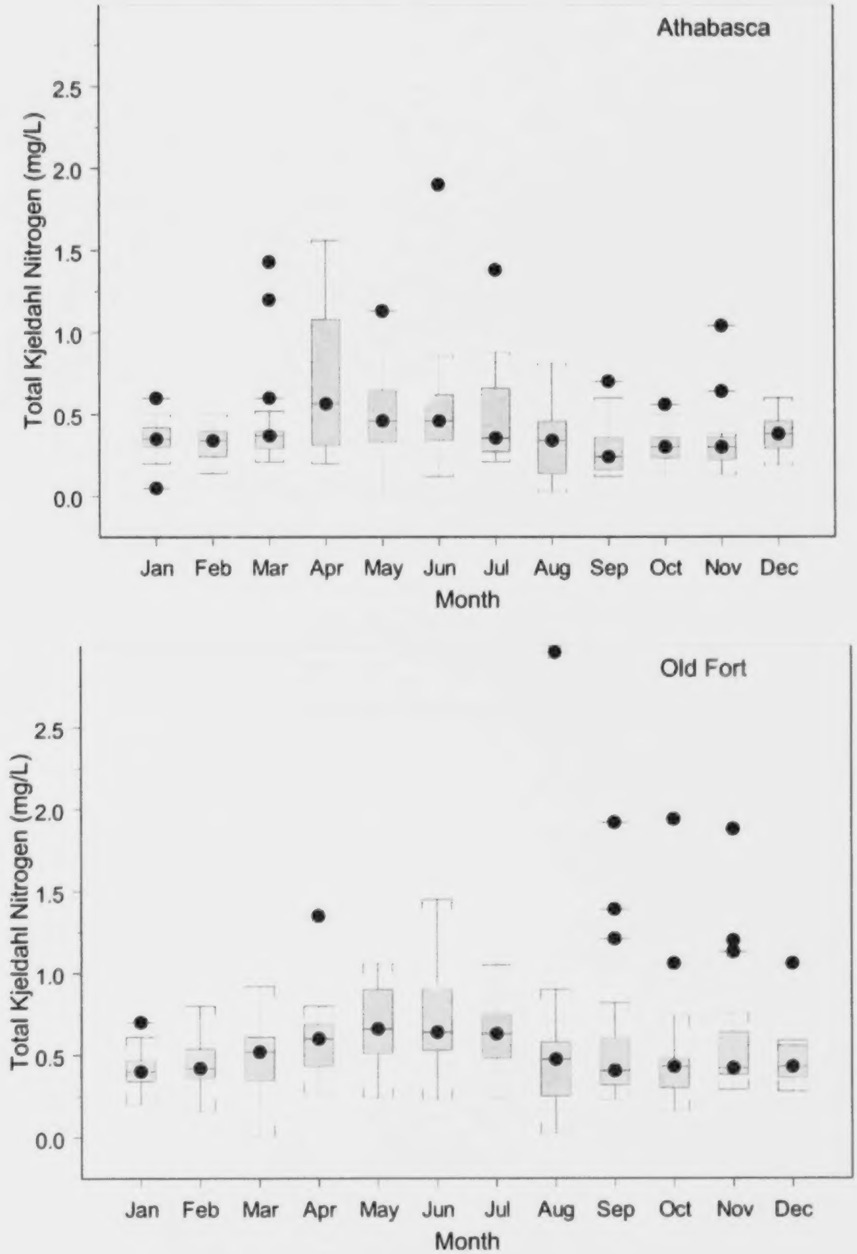
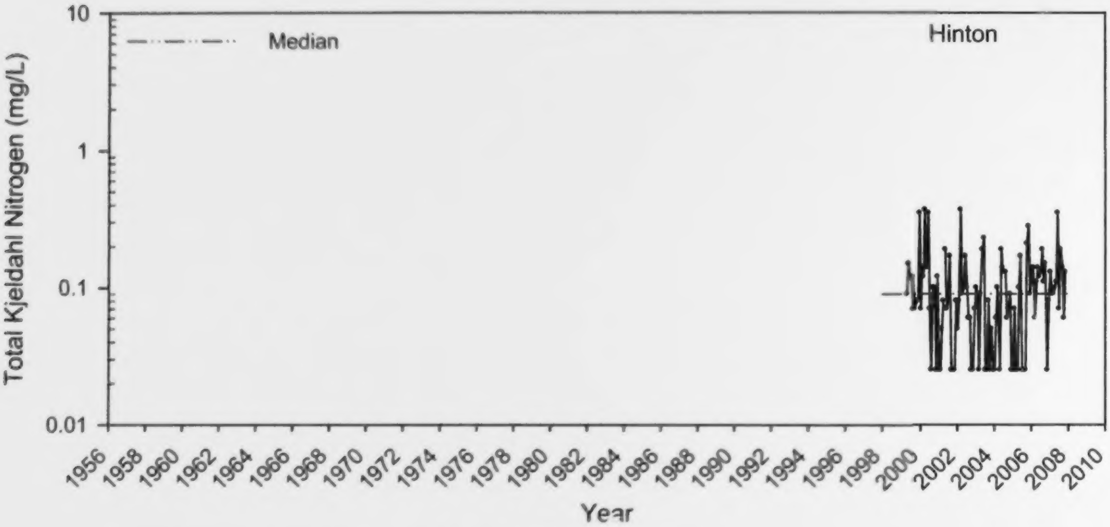
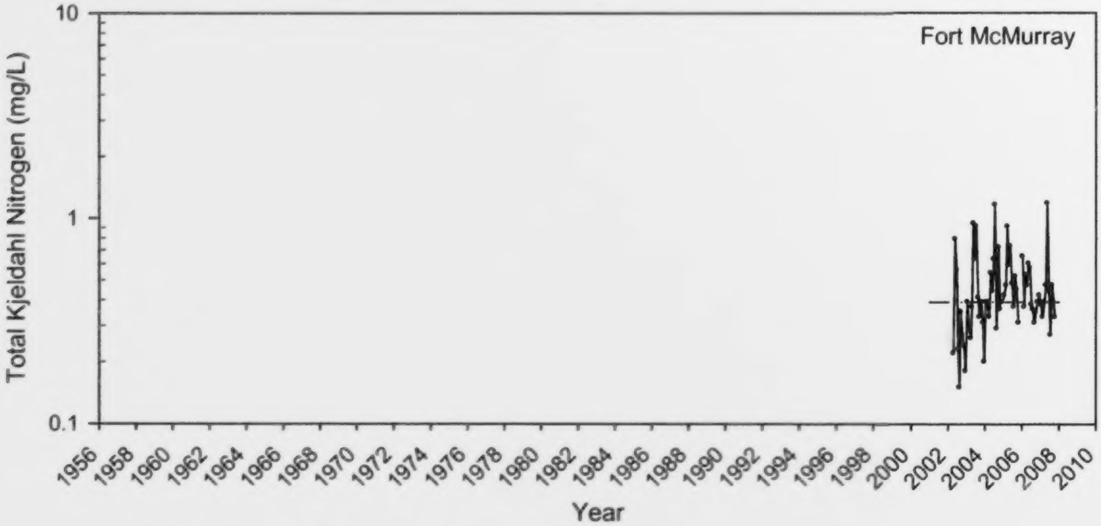


Figure 105 Seasonality of total Kjeldahl nitrogen in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.09		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.39		
Flow Adjusted								

Figure 106 Total Kjeldahl nitrogen concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

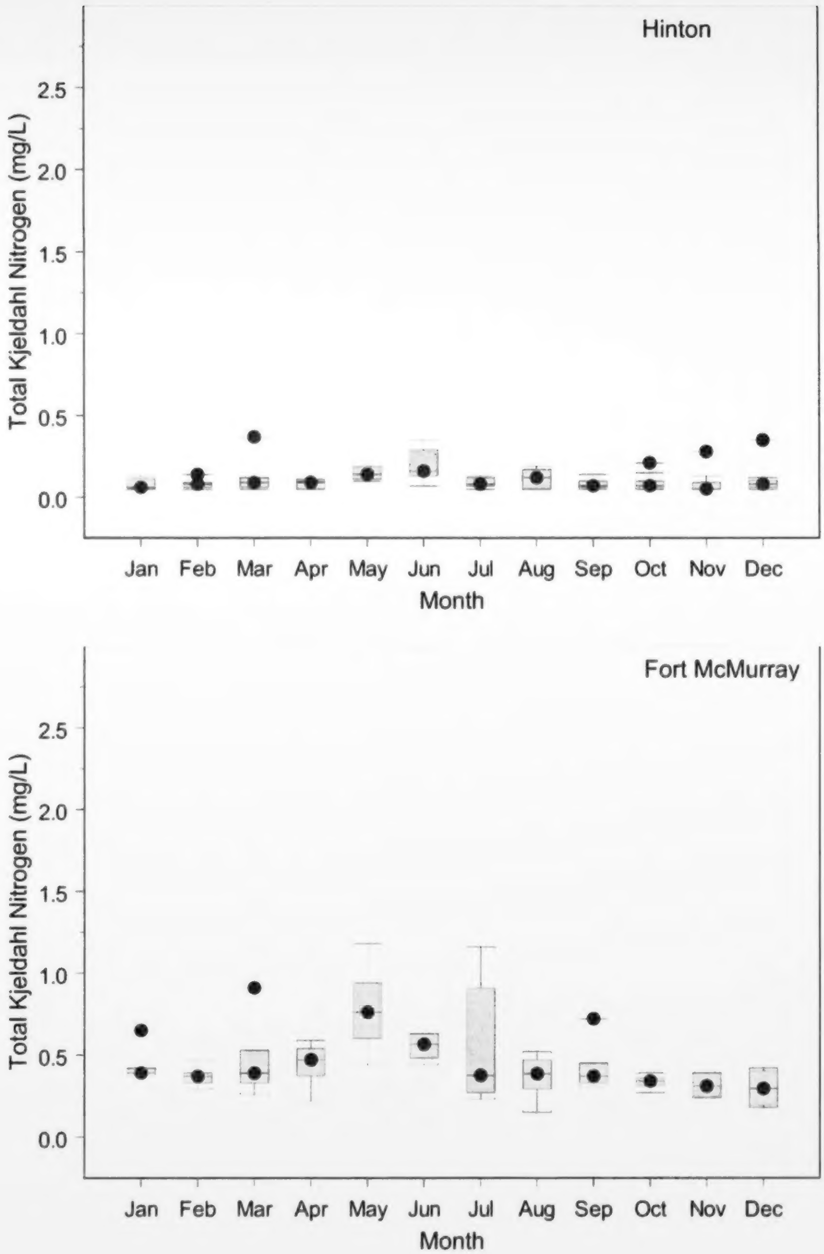
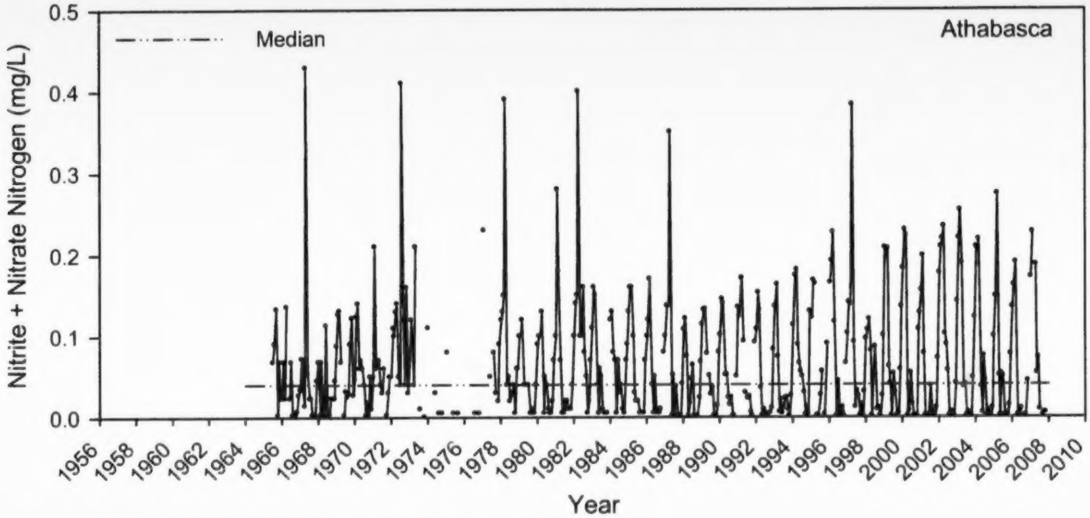
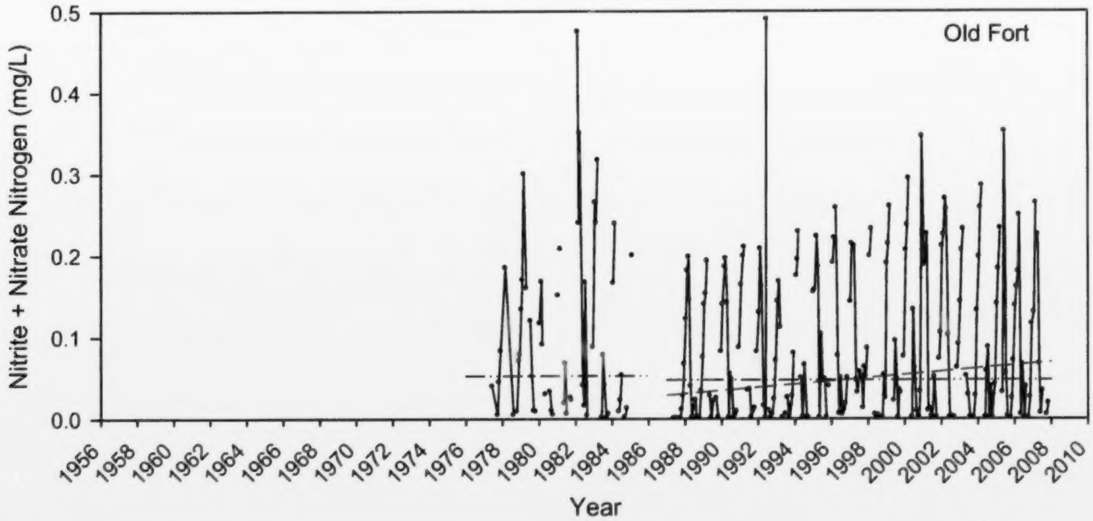


Figure 107 Seasonality of Total Kjeldahl nitrogen in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
-0.8872%	NS	NS	0.04	0.9110%	NS	0.04	-0.1031%	NS
Flow Adjusted								
0.0001	NS			0.0010	up		0.0007	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
2.2366%	NS	down	0.05	ID	ID	0.05	4.0357%	up
Flow Adjusted								
-0.0004	NS			ID	ID		0.0006	NS

Figure 108 Nitrite and nitrate nitrogen concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., p<0.05). ID = Insufficient Data, NS = Not Significant.

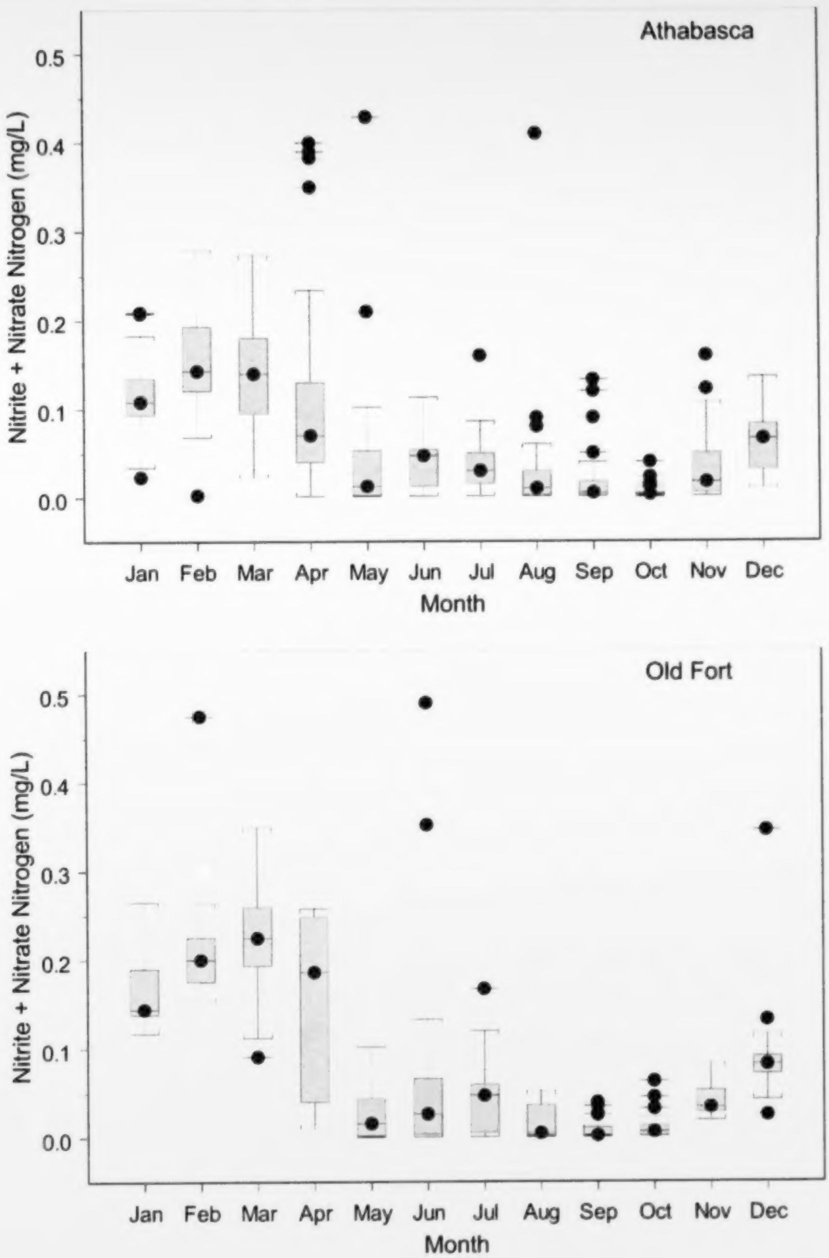
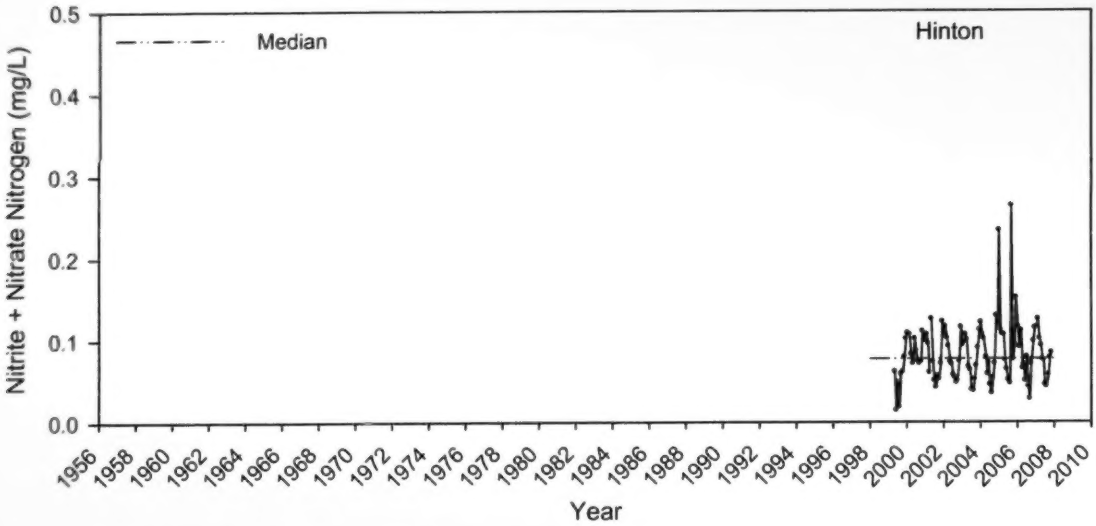
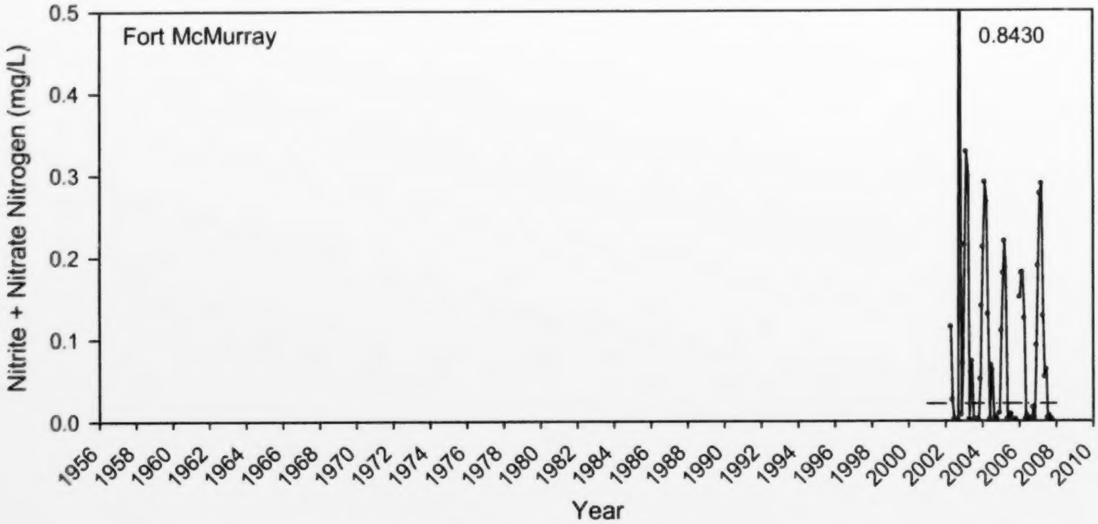


Figure 109 Seasonality of nitrite and nitrate nitrogen in the Athabasca River at Athabasca and Old Fort.

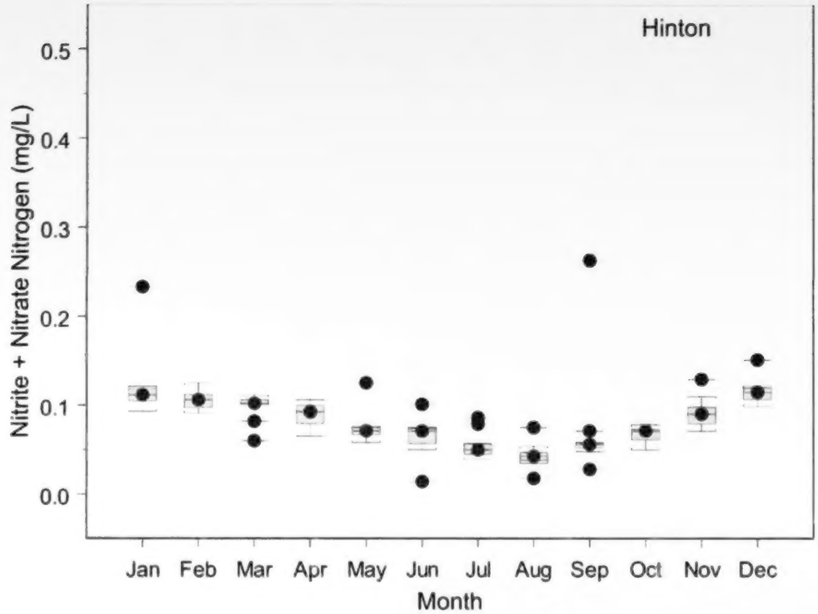


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.08		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.02		
Flow Adjusted								

Figure 110 Nitrite and nitrate nitrogen concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.



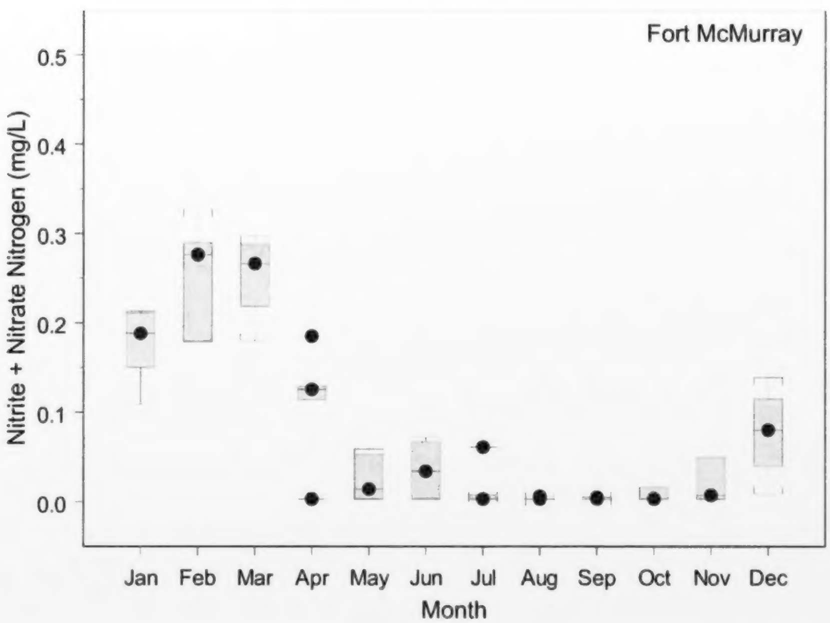
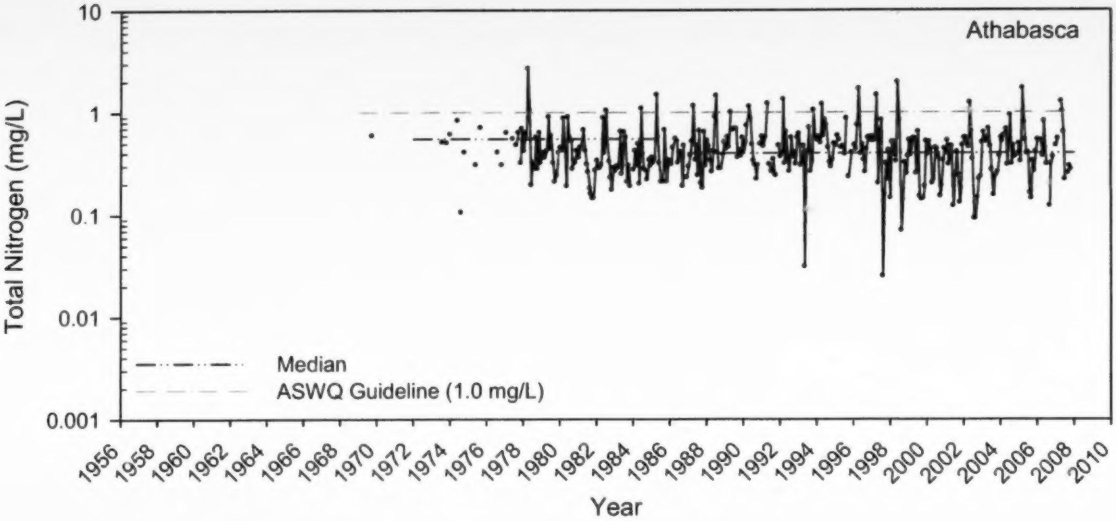
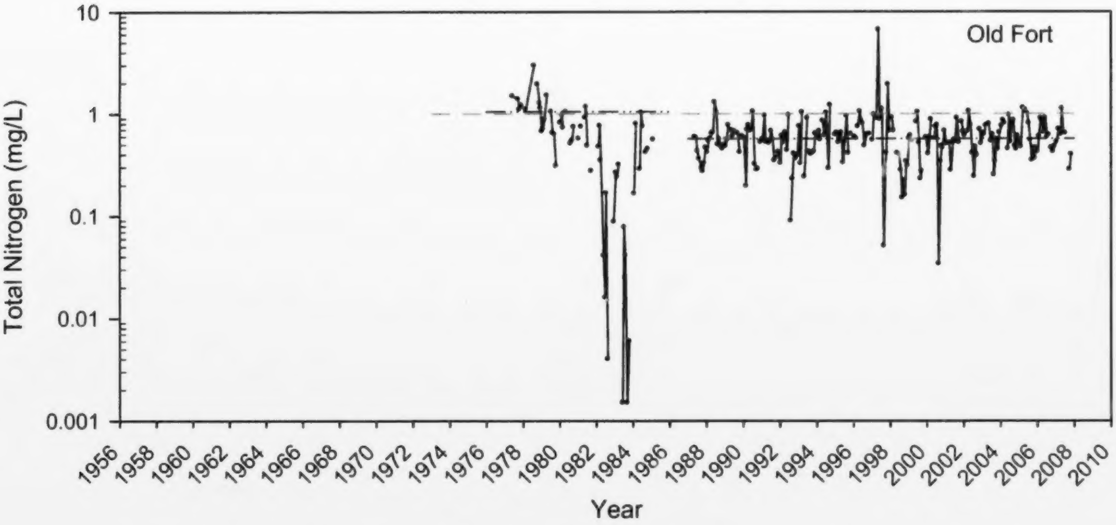


Figure 111 Seasonality of nitrite and nitrate nitrogen in the Athabasca River at Hinton and Fort McMurray. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0016	NS	down	0.55	-0.0100	NS	0.40	-0.0027	NS
Flow Adjusted								
0.0019	NS			-0.0103	NS		-0.0027	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0010	NS	down	1.05	ID	ID	0.57	0.0026	NS
Flow Adjusted								
0.0020	NS			ID	ID		0.0034	NS

Figure 112 Total nitrogen concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

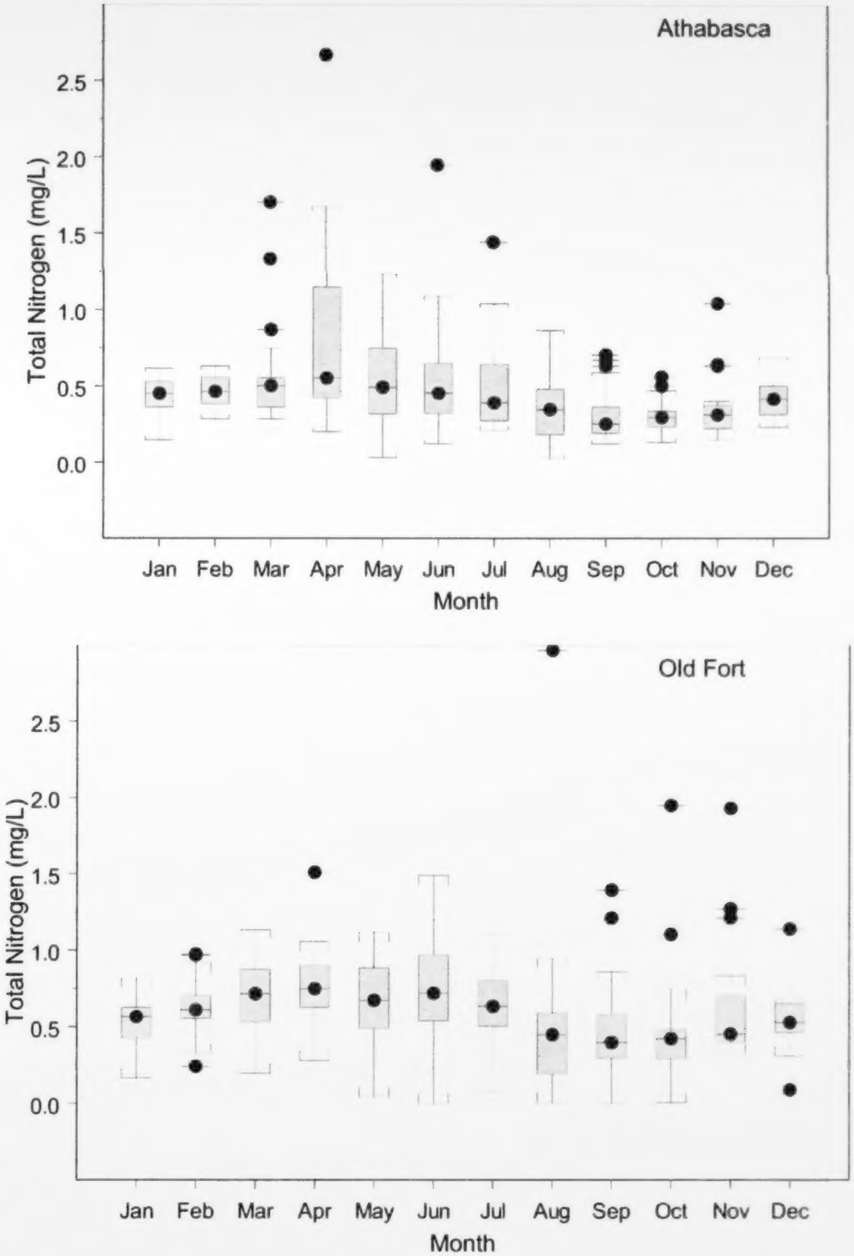
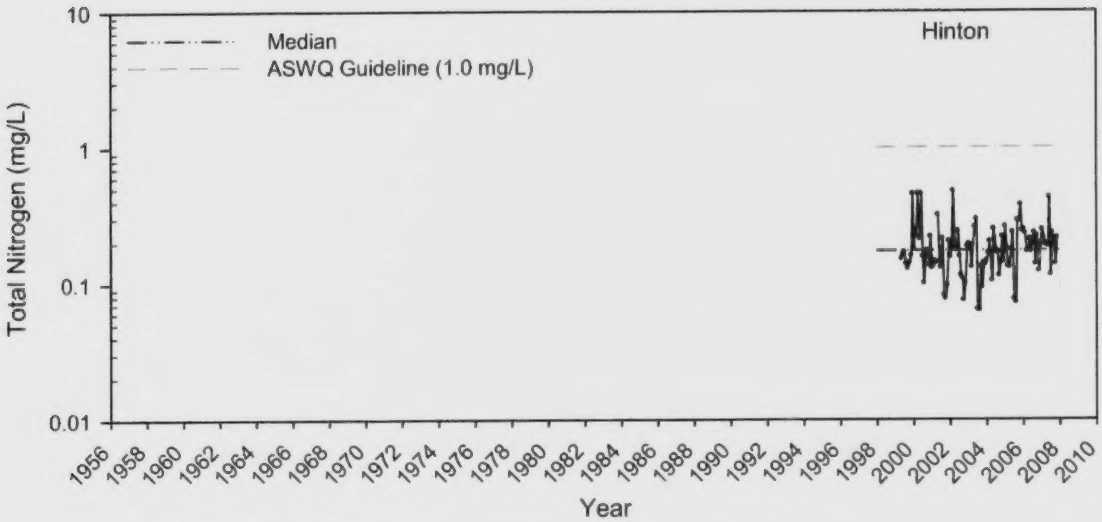
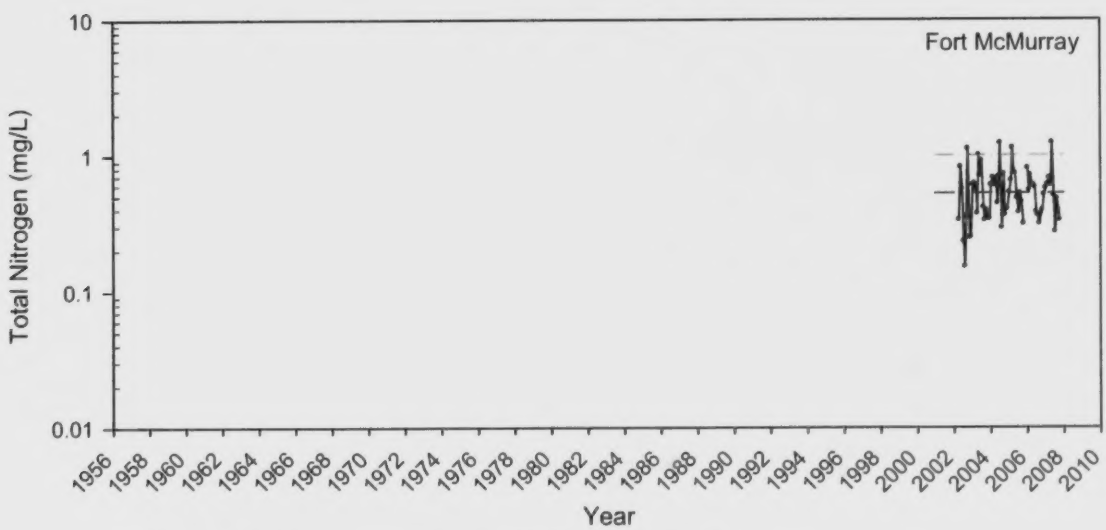


Figure 113 Seasonality of total nitrogen in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.17		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.53		
Flow Adjusted								

Figure 114 Total nitrogen concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

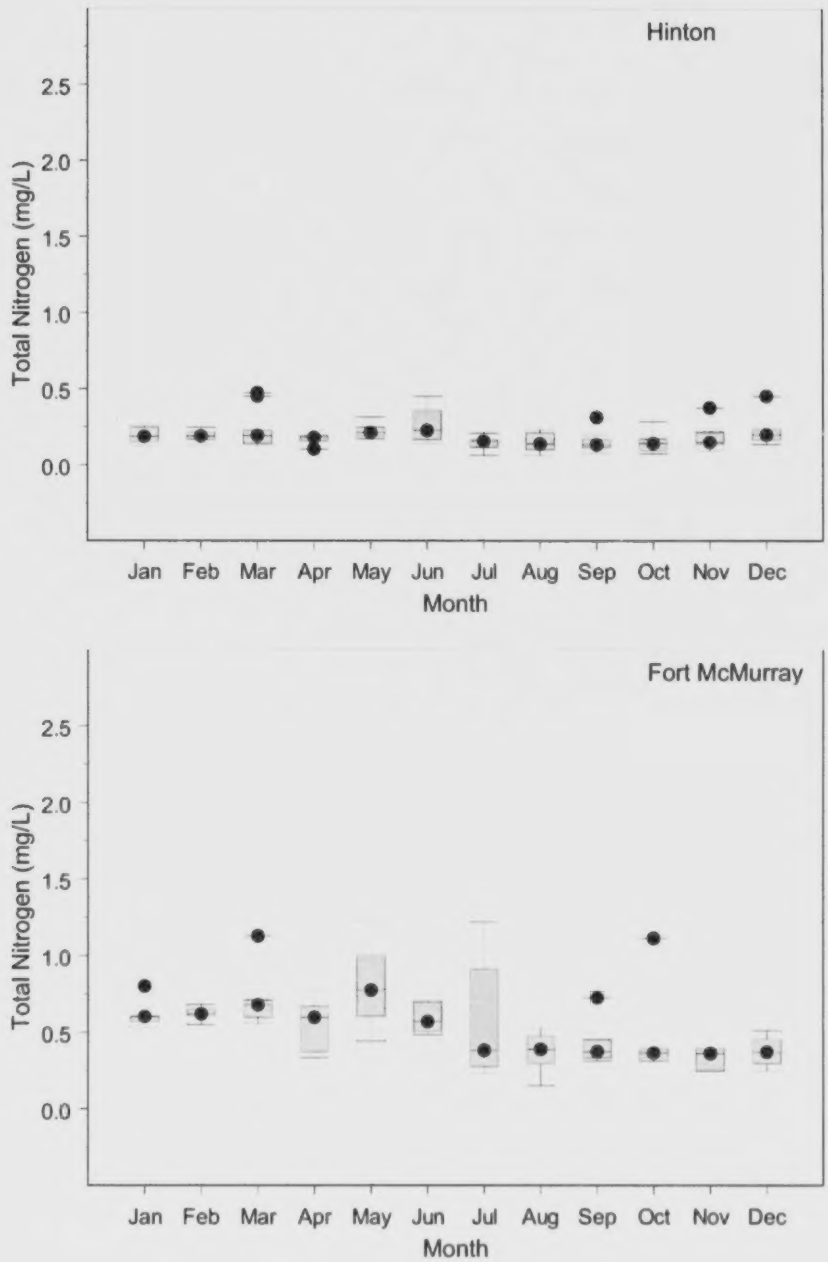
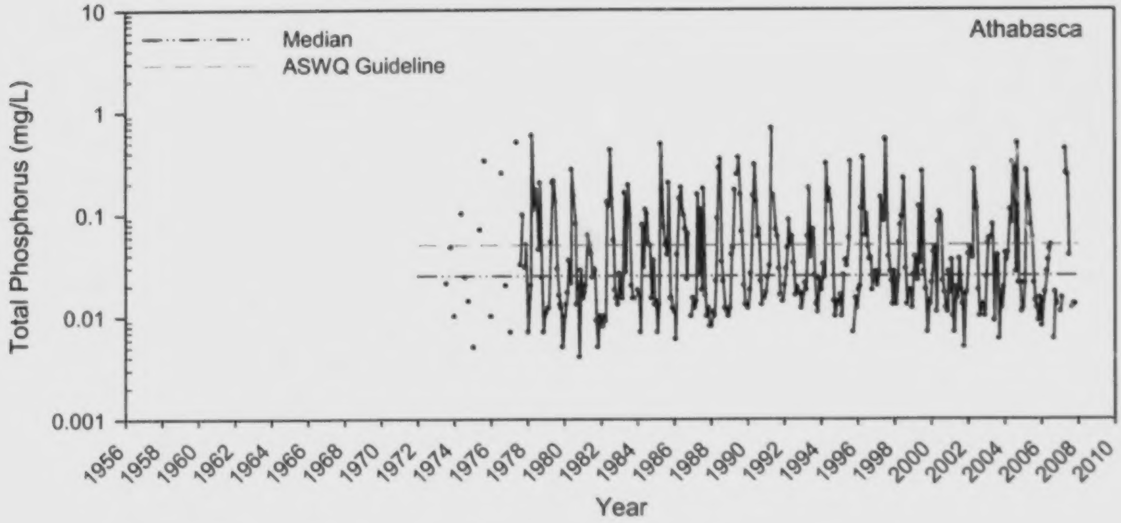
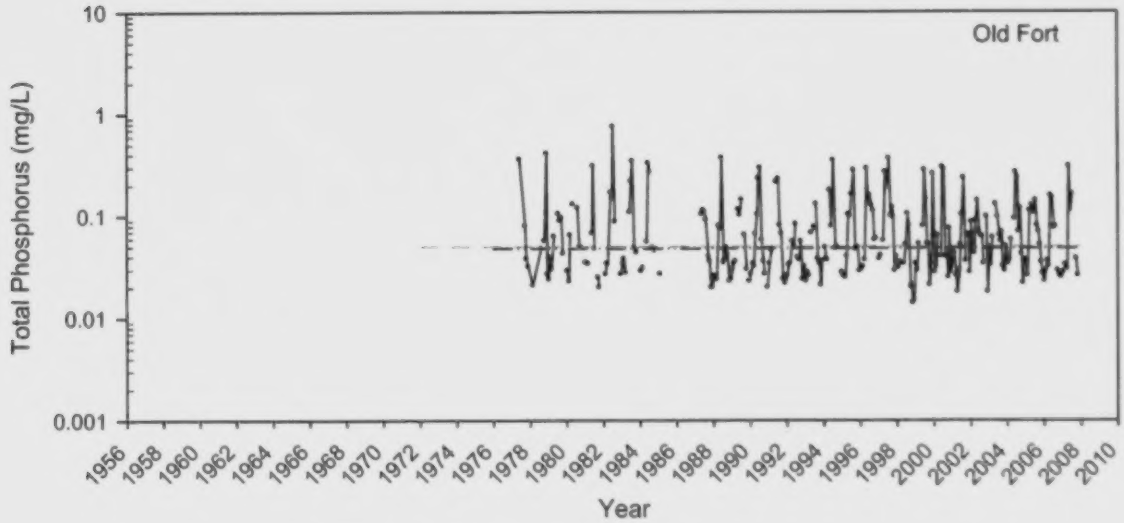


Figure 115 Seasonality of total nitrogen in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0000	NS	NS	0.03	0.0000	NS	0.03	-0.0001	NS
Flow Adjusted								
0.0003	up			-0.0005	NS		-0.0002	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0001	NS	NS	0.0485	ID	ID	0.0475	0.0004	NS
Flow Adjusted								
0.0003	up			ID	ID		0.0007	up

Figure 116 Total phosphorus concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

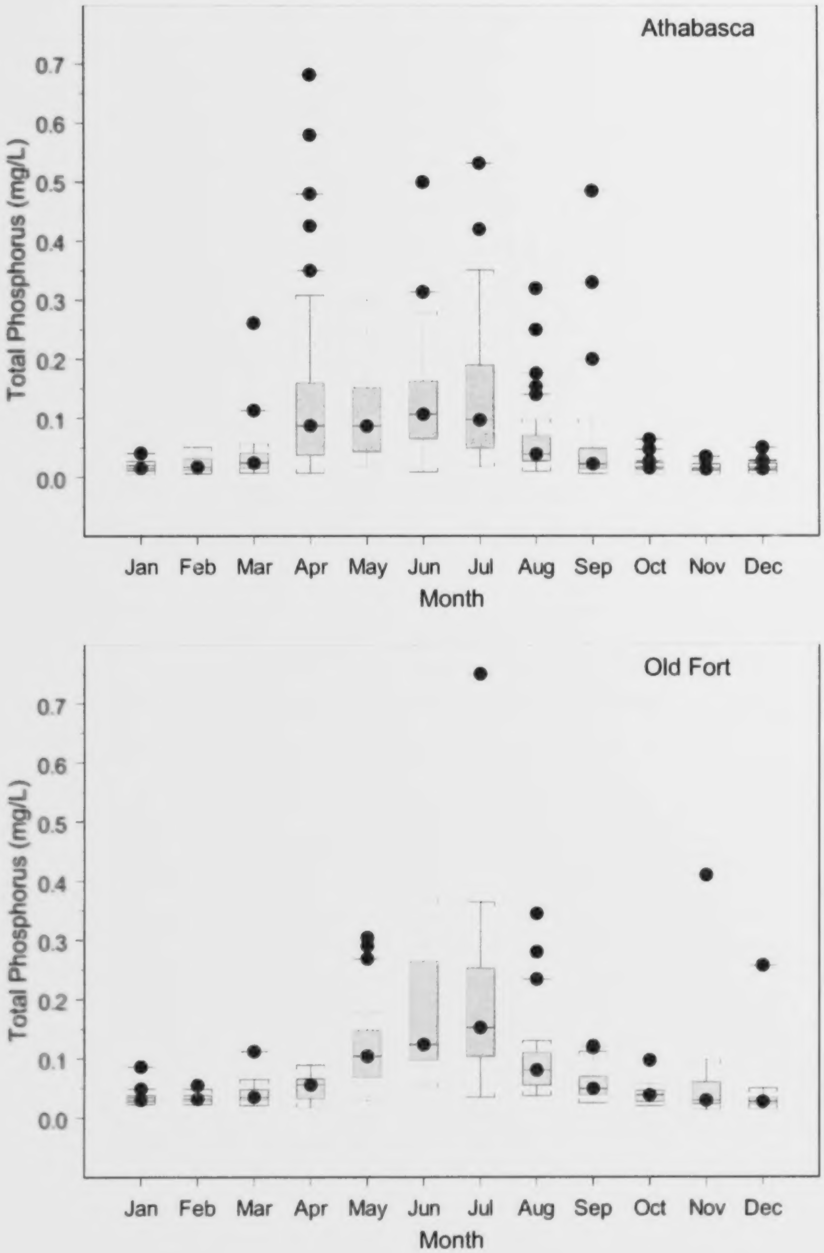
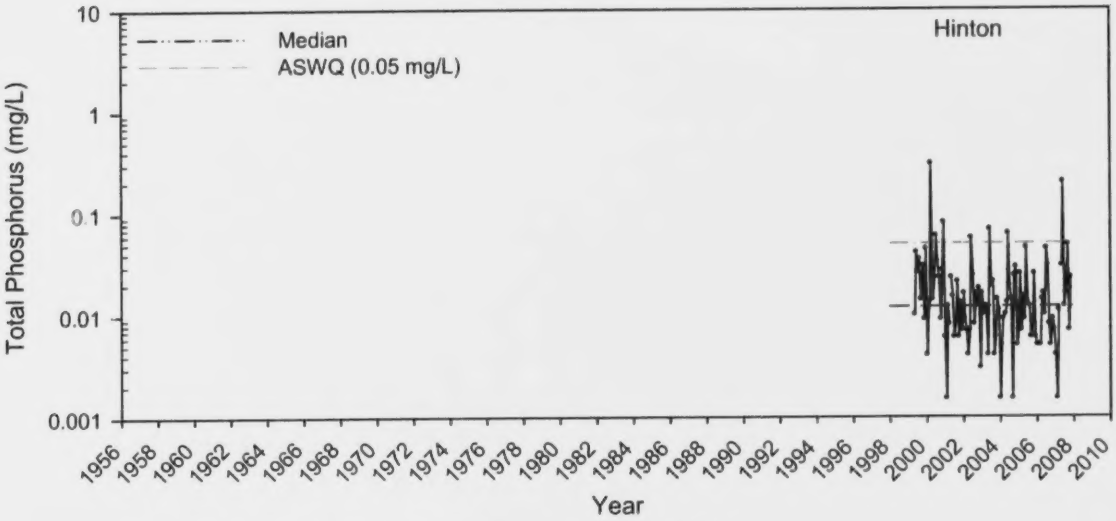
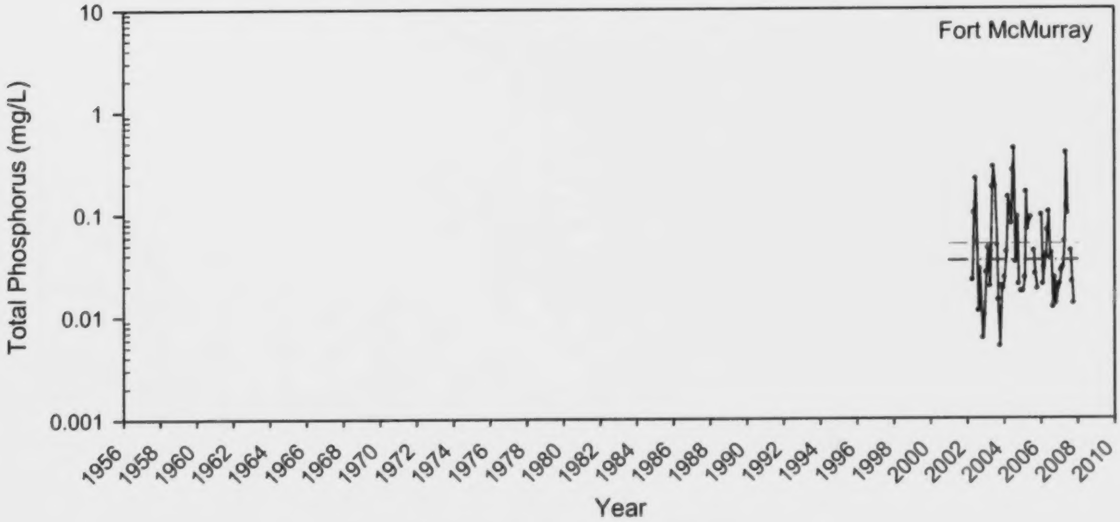


Figure 117 Seasonality of total phosphorus in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0120		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0345		
Flow Adjusted								

Figure 118 Total phosphorus in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

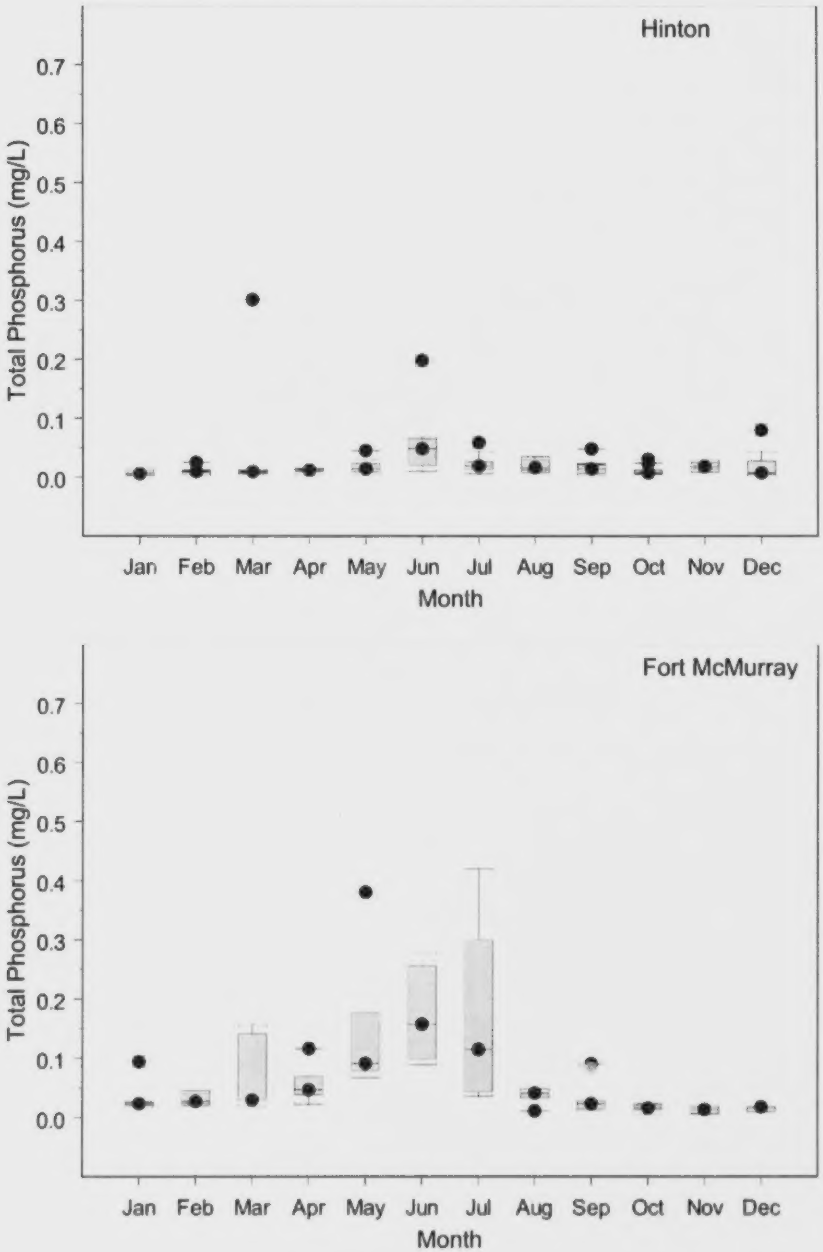
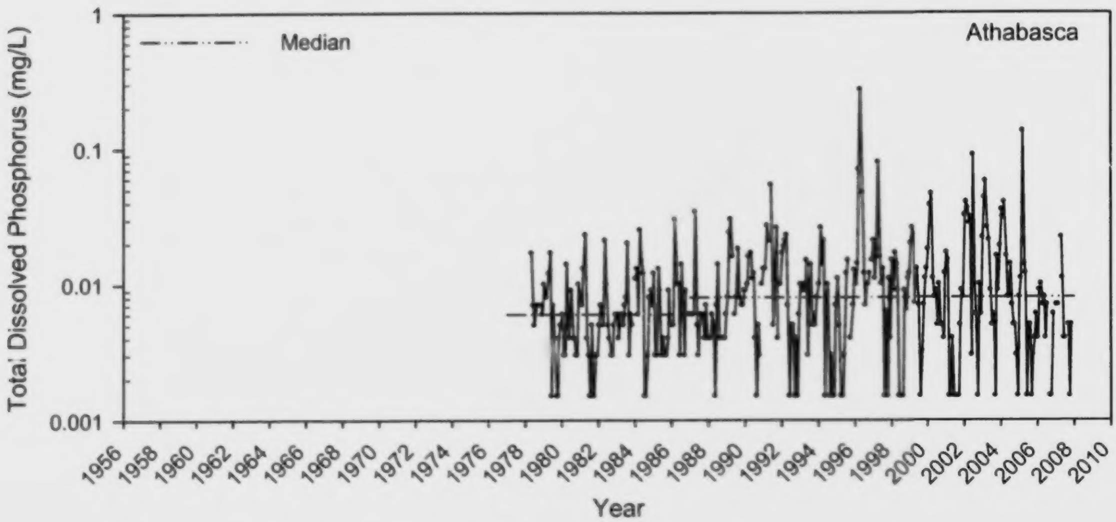
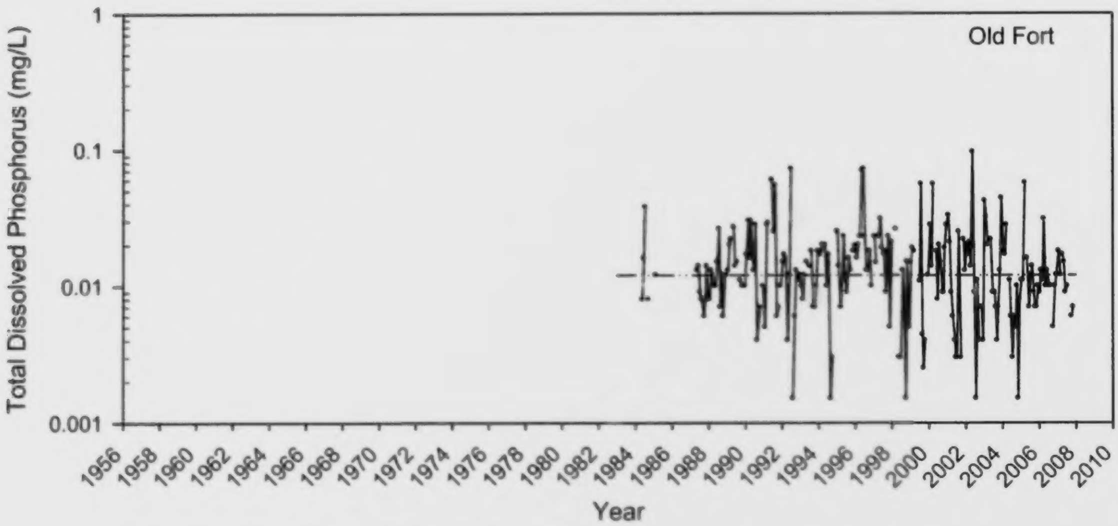


Figure 119 Seasonality of total phosphorus in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
1.9099%	up	up	0.006	0.1710%	NS	0.008	0.5419%	NS
Flow Adjusted								
0.0001	NS			0.0001	NS		0.0000	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	ID	0.012	ID	ID	0.012	-0.6466%	NS
Flow Adjusted								
ID	ID			ID	ID		-0.0001	NS

Figure 120 Total dissolved phosphorus concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

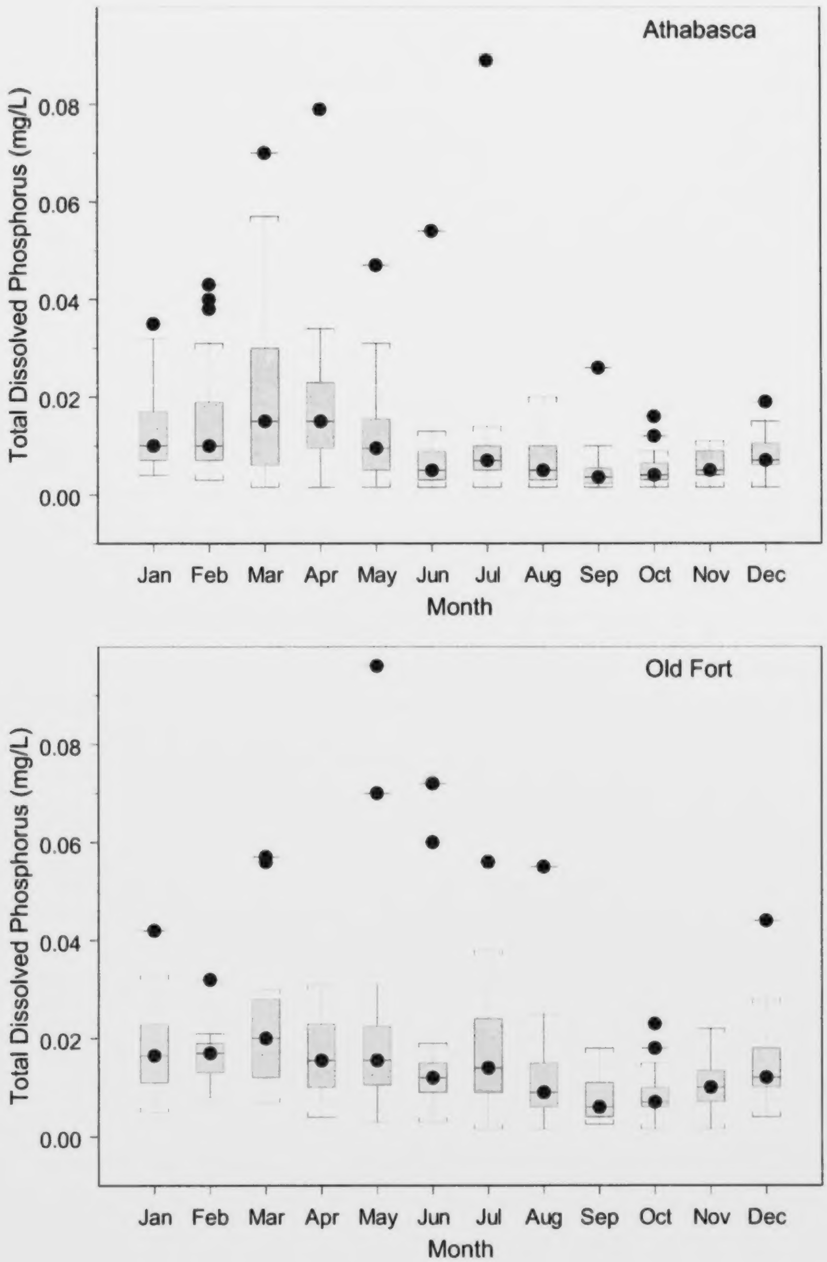
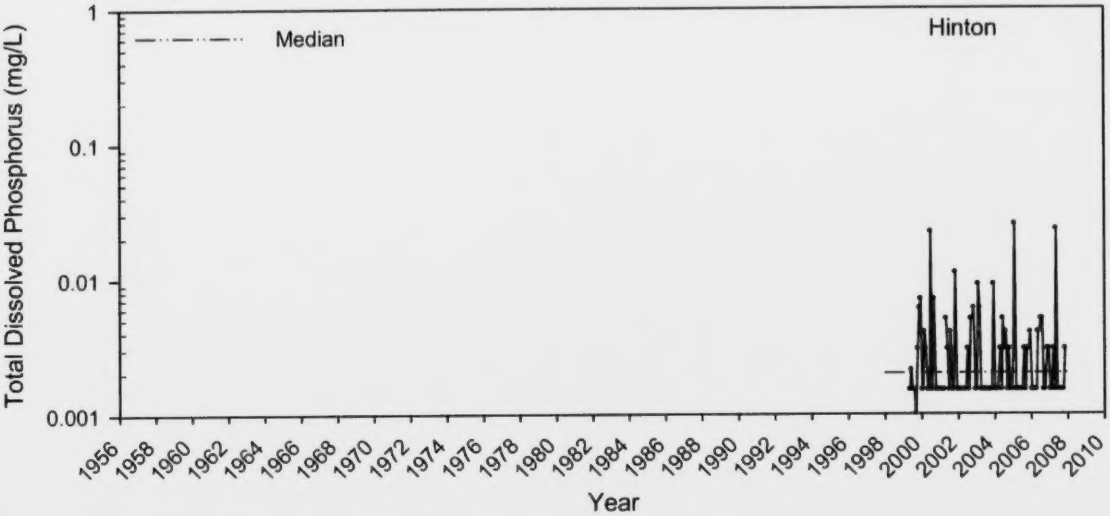
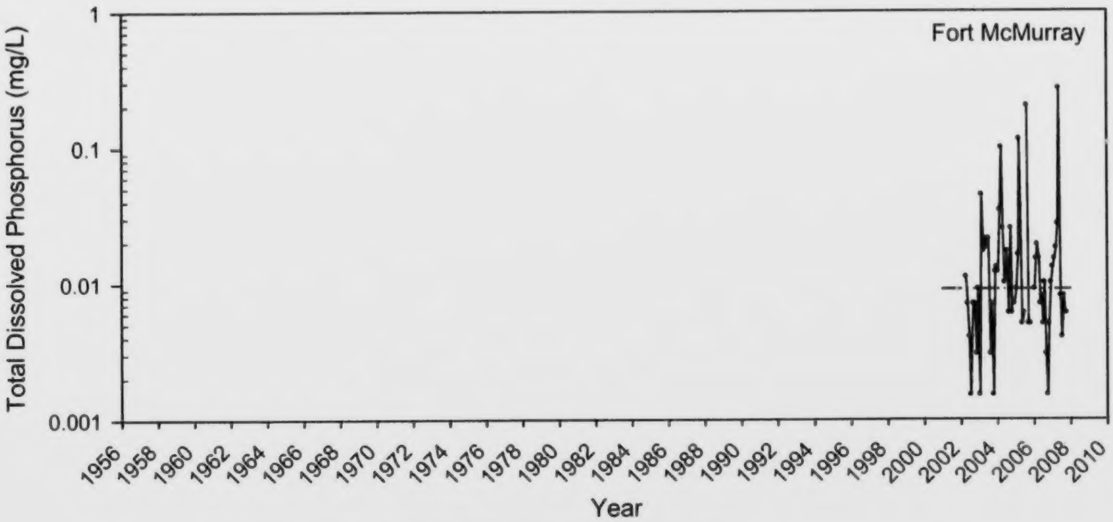


Figure 121 Seasonality of total dissolved phosphorus in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.

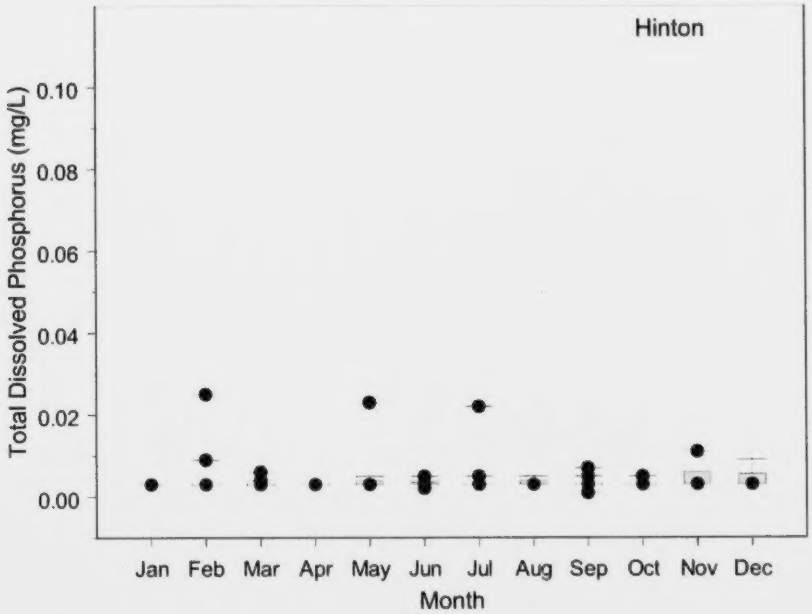


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0020		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0090		
Flow Adjusted								

Figure 122 Total dissolved phosphorus concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.



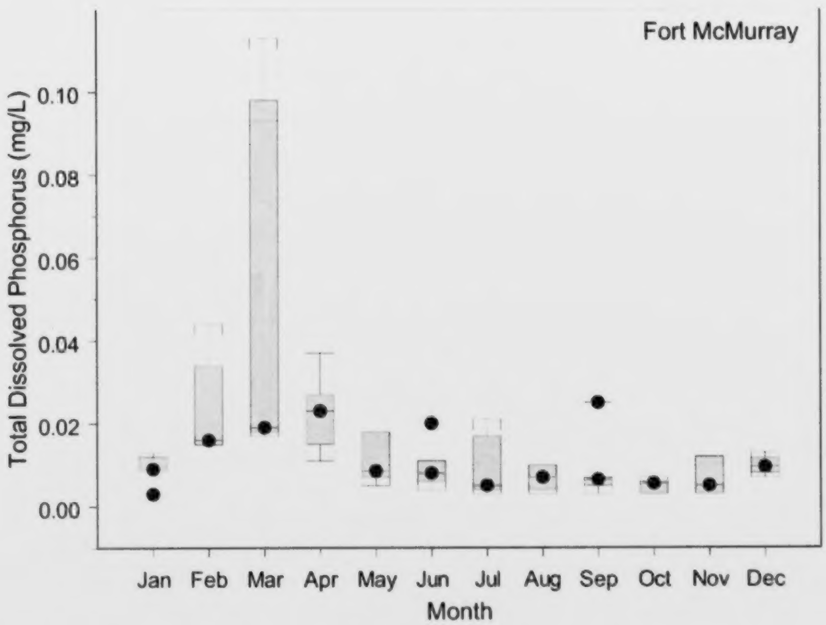
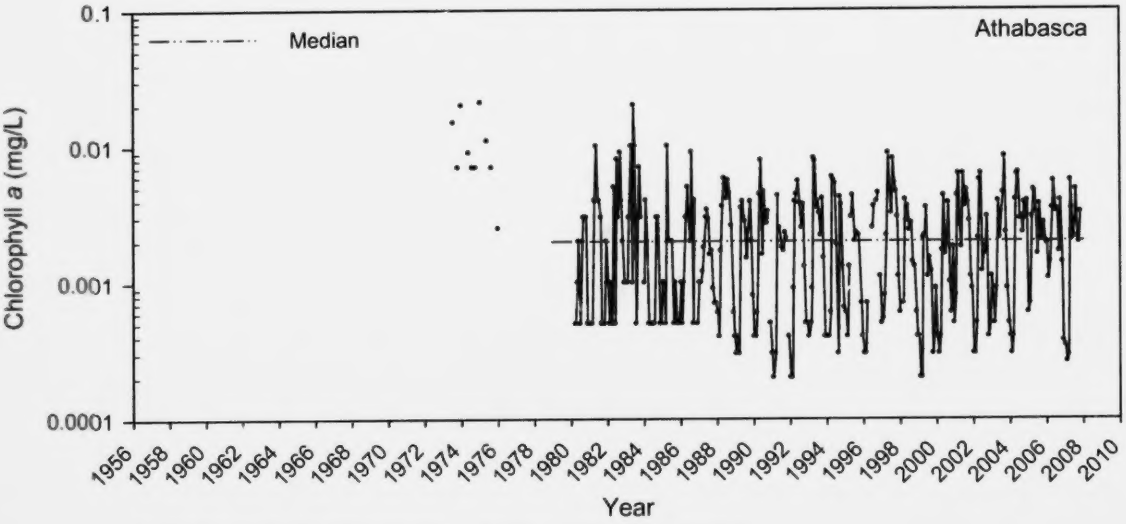
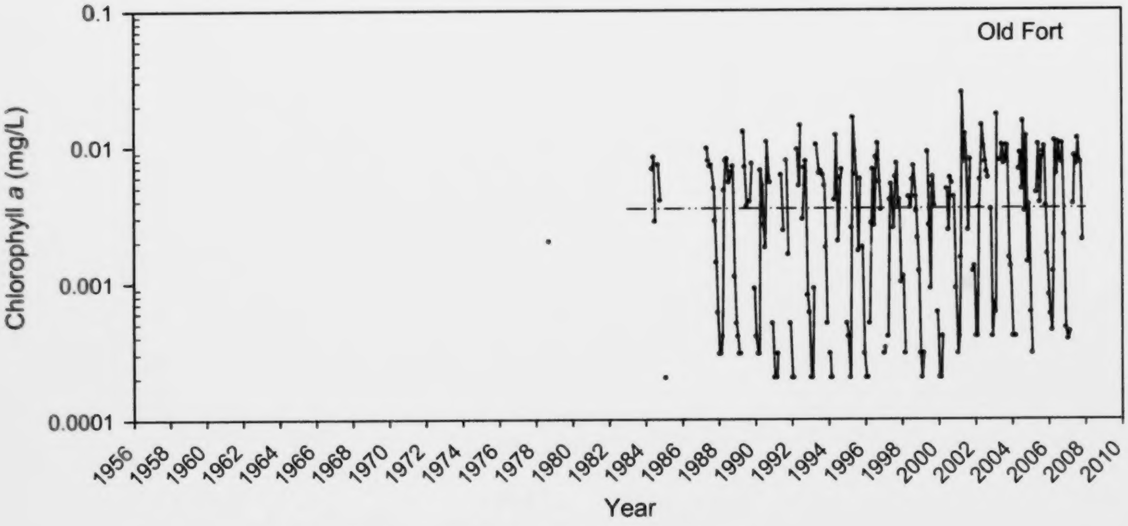


Figure 123 Seasonality of total dissolved phosphorus in the Athabasca River at Hinton and Fort McMurray. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0000	NS	down	0.002	ID	ID	0.002	0.0000	NS
Flow Adjusted								
0.0000	NS			ID	ID		0.0000	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	ID	0.004	ID	ID	0.0035	0.0000	NS
Flow Adjusted								
ID	ID			ID	ID		0.0000	NS

Figure 124 Chlorophyll *a* concentration in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

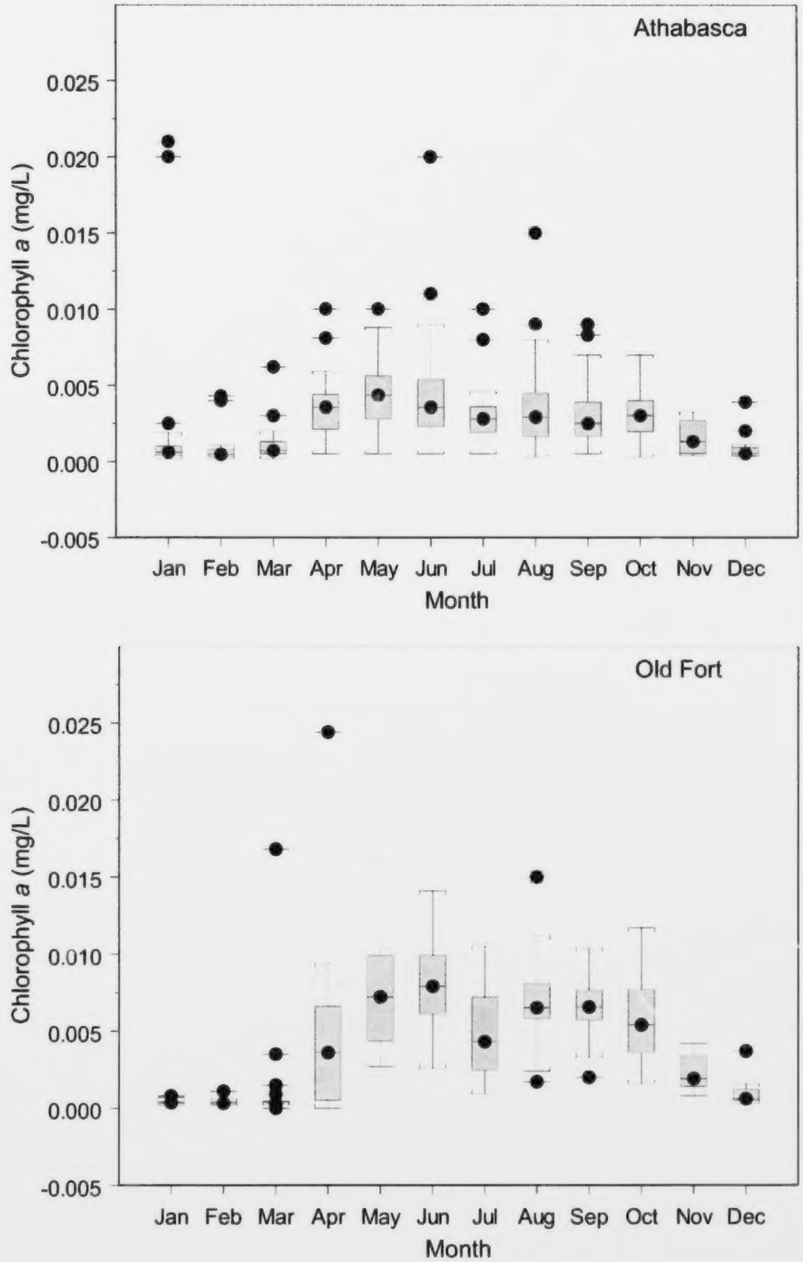
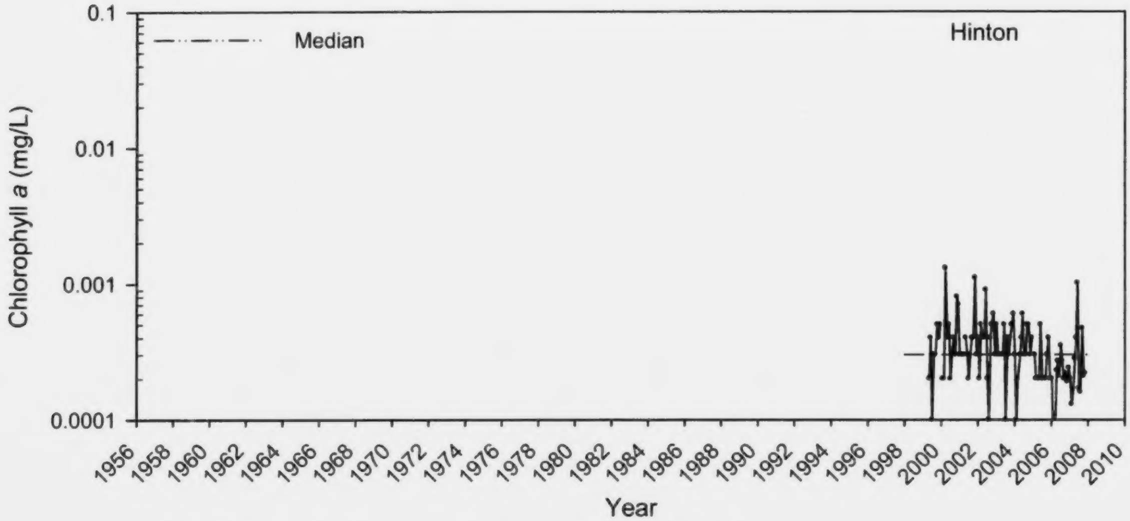
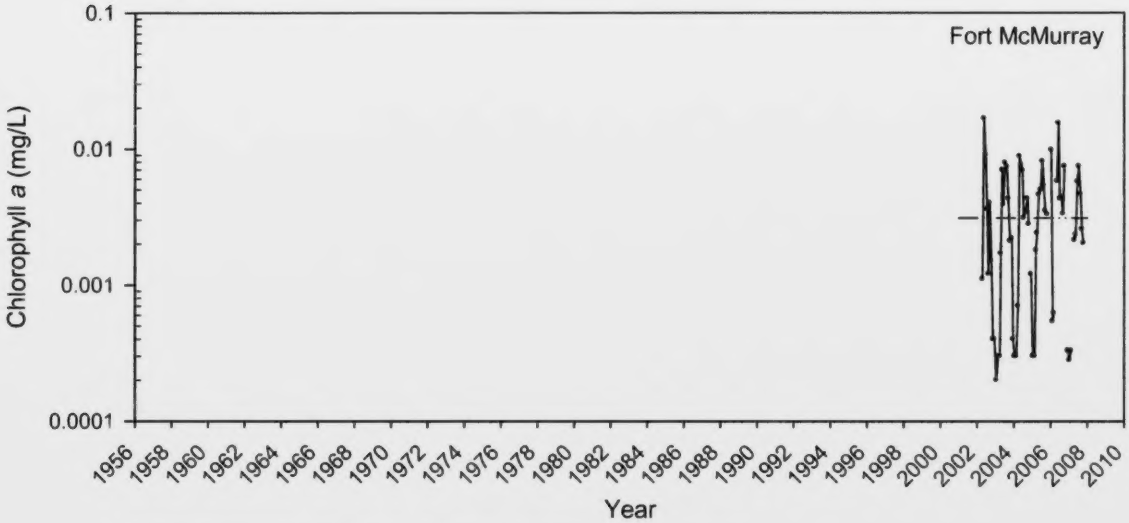


Figure 125 Seasonality of chlorophyll *a* in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0003		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0031		
Flow Adjusted								

Figure 126 Chlorophyll *a* concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

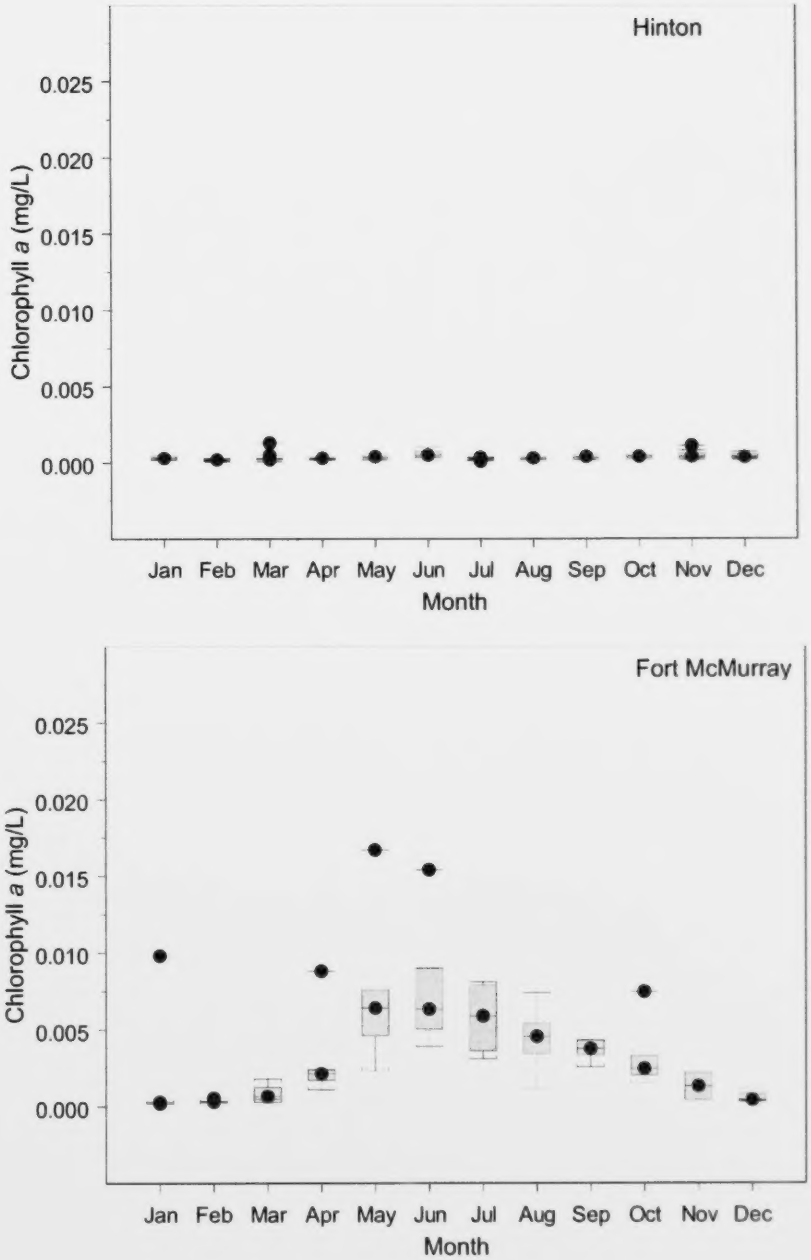
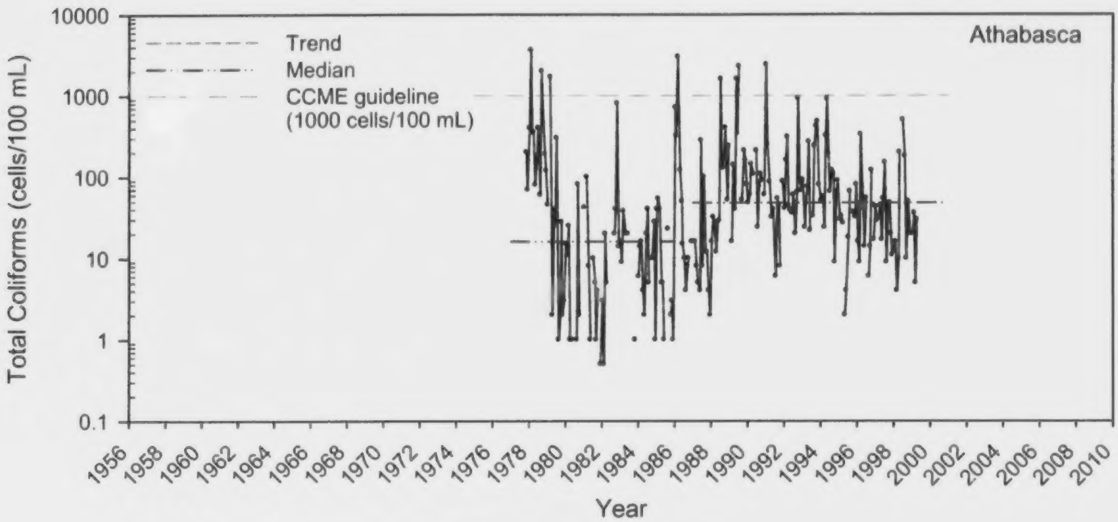
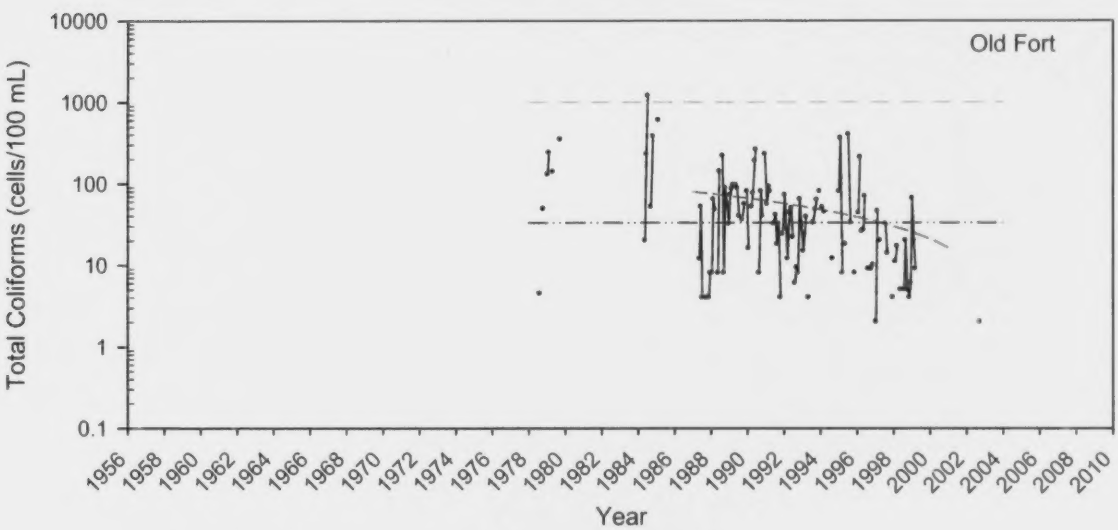


Figure 127 Seasonality of chlorophyll *a* concentration in the Athabasca River at Hinton and Fort McMurray.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.5714	NS	up	16.00	-1.2500	NS	48.00	-4.5000	NS
Flow Adjusted								
0.3446	NS			-5.8417	NS		-5.0829	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	NS	185.00	ID	ID	32.00	-4.5000	down
Flow Adjusted								
ID	ID			ID	ID		-4.3281	none

Figure 128 Total coliform bacteria in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). ID = Insufficient Data, NS = Not Significant.

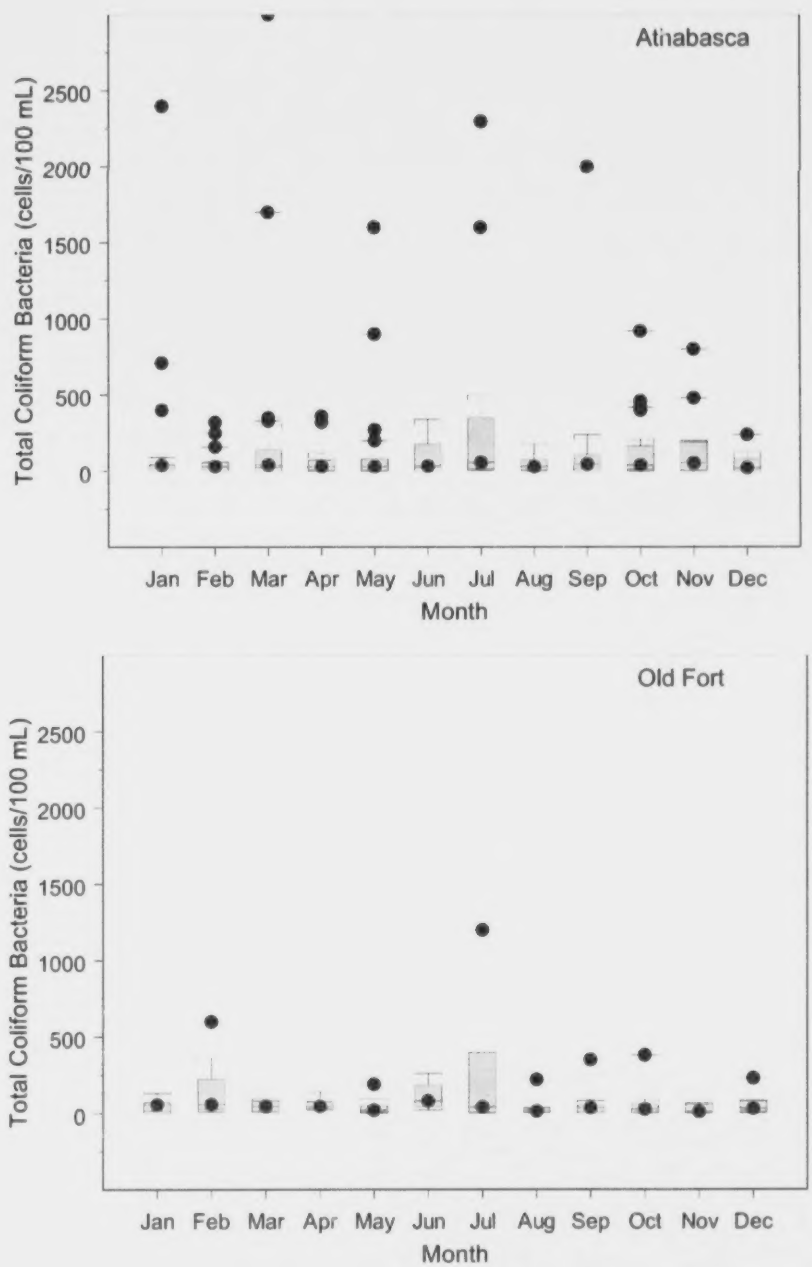
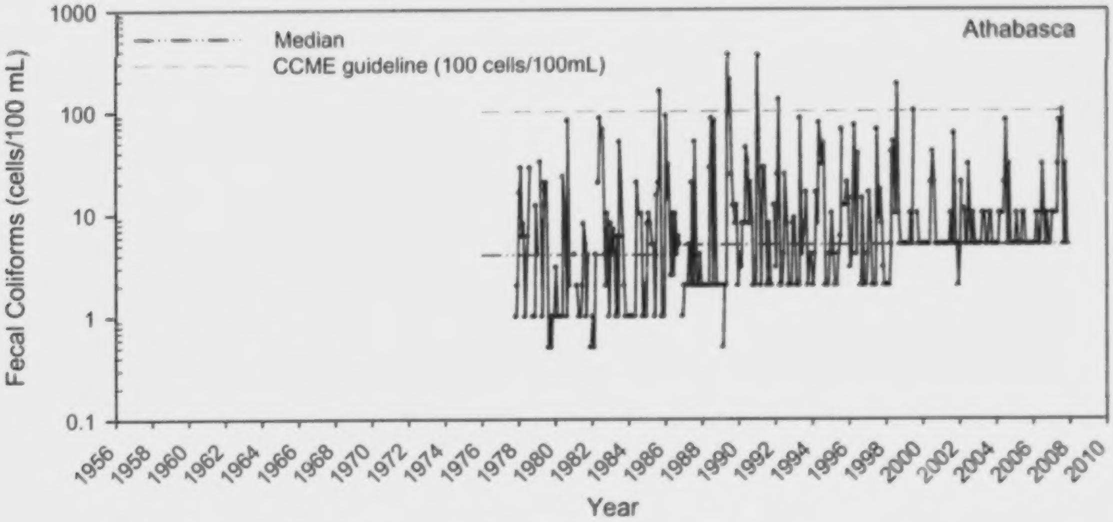
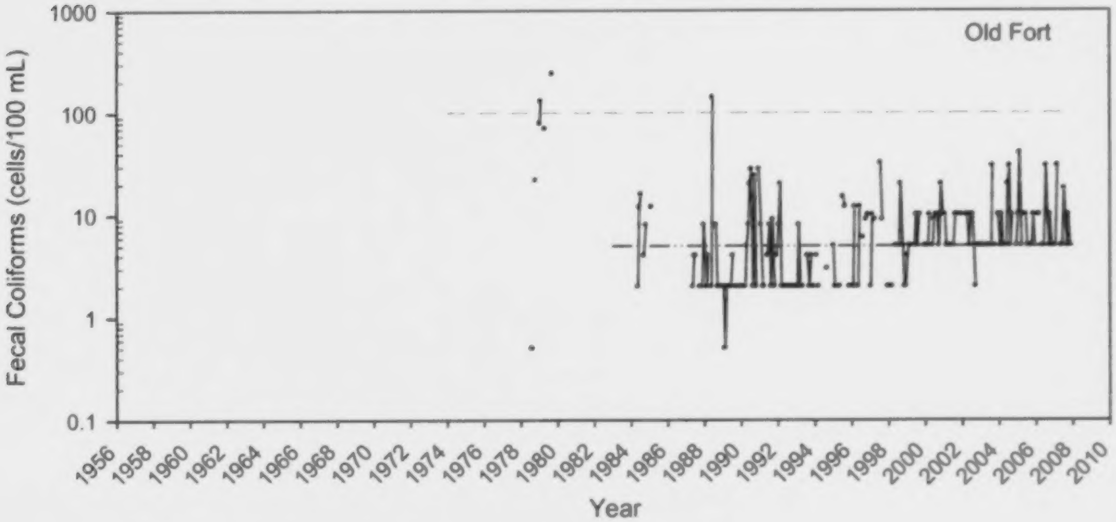


Figure 129 Seasonality of total coliform bacteria in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987			Post-1987		
%Slope	Sig.	Significance	Median	%Slope	Sig.	Median	%Slope	Sig.
2.5776%	up	up	4.00	2.6139%	NS	5.00	0.5830%	NS
Slope	Flow Adjusted						Slope	
0.3226	up			-1.7881%	NS		2.1009	NS



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
ID	ID	ID	14.00	ID	ID	5.00	ID	ID
Flow Adjusted								
ID	ID			ID	ID		ID	ID

Figure 130 Fecal coliform bacteria in the Athabasca River at Athabasca and Old Fort. Significance of step trends and monotonic trends was determined at a 95% confidence interval (i.e., p<0.05). ID = Insufficient Data, NS = Not Significant.

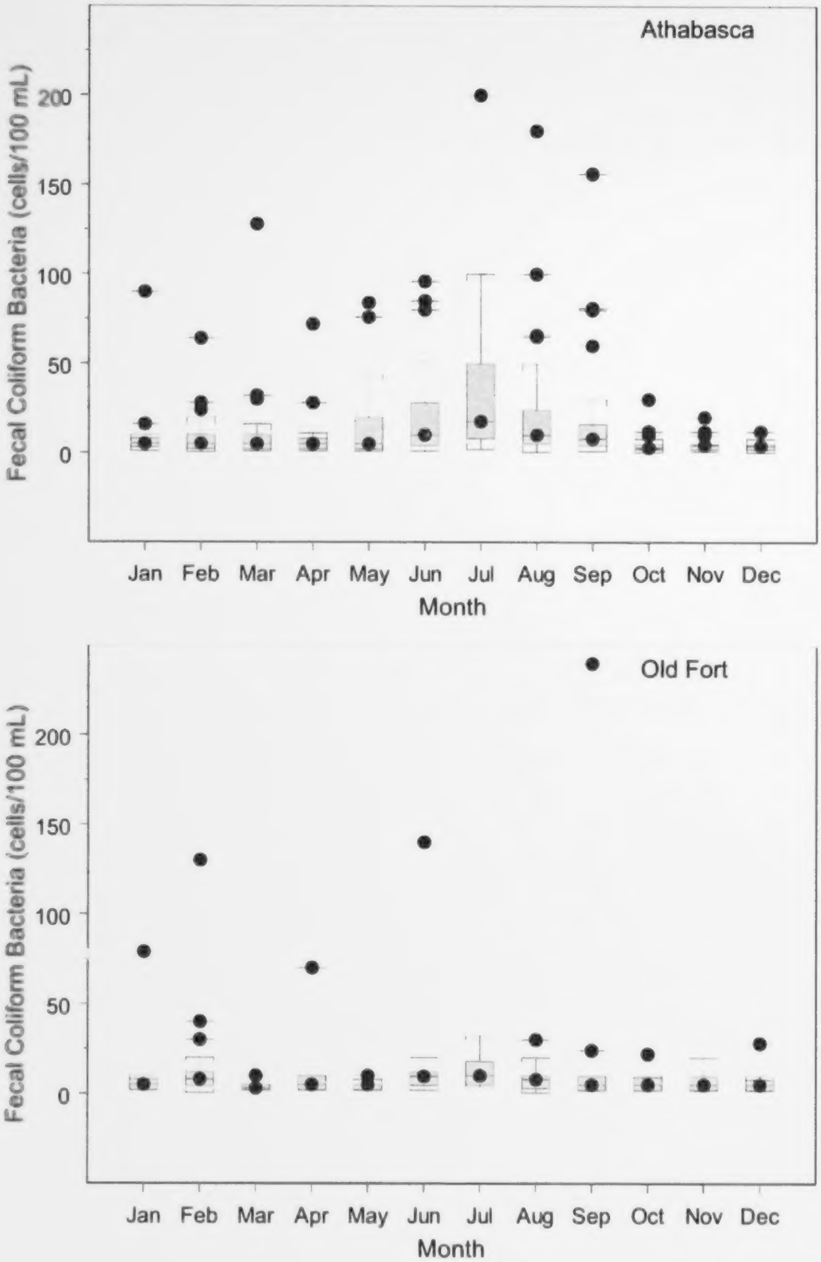
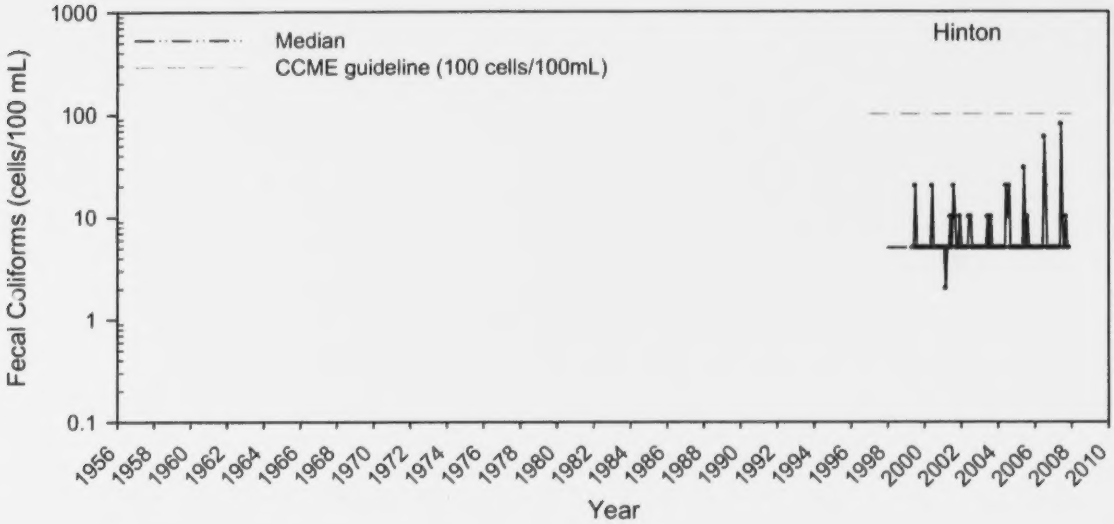
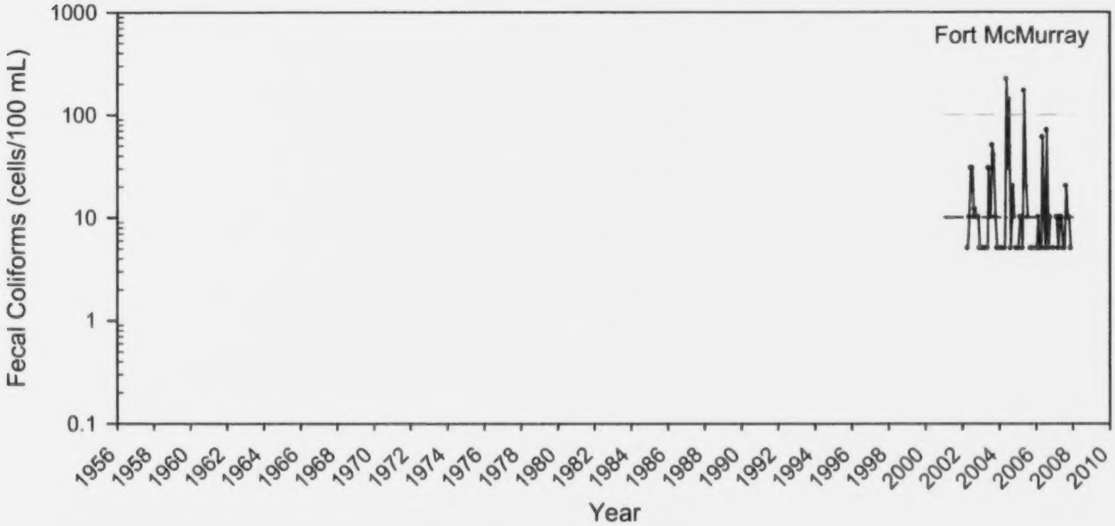


Figure 131 Seasonality of fecal coliform bacteria in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						5.00		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						10.00		
Flow Adjusted								

Figure 132 Fecal coliform bacteria in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.

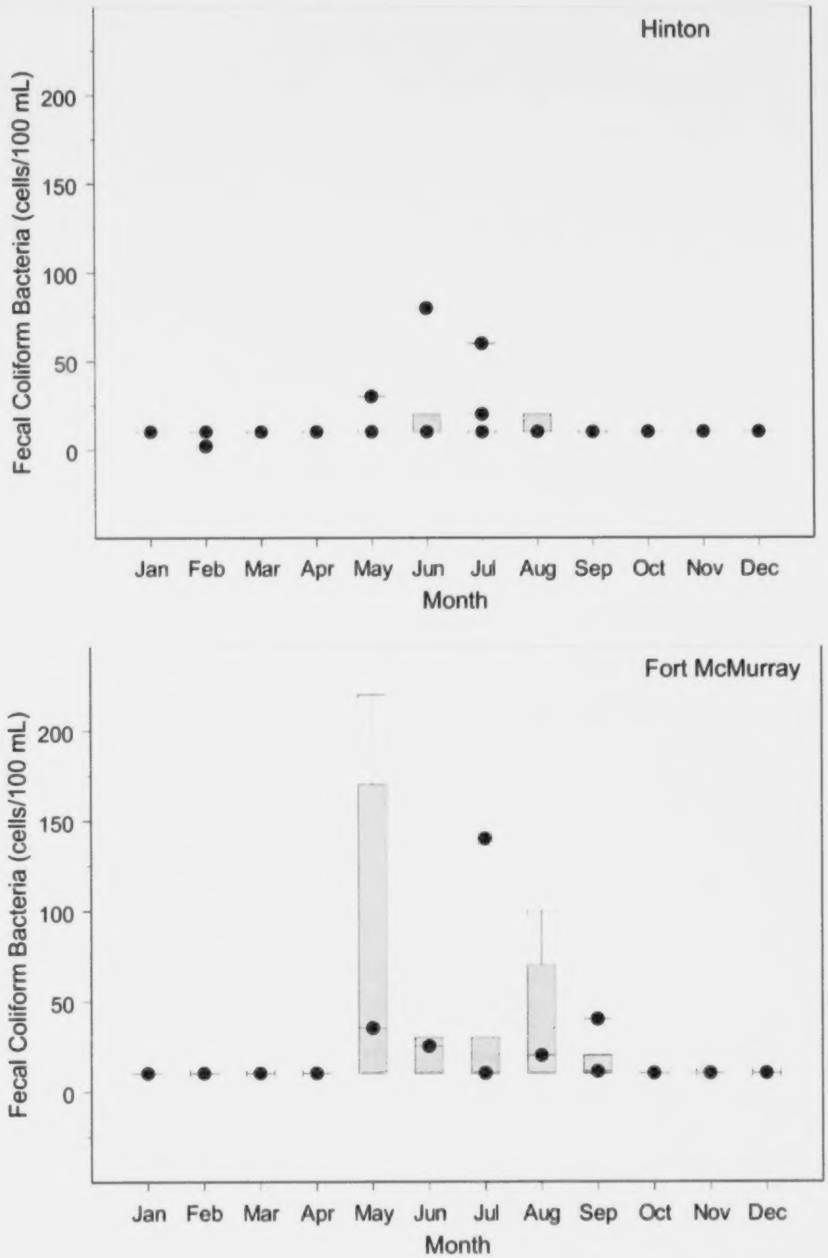
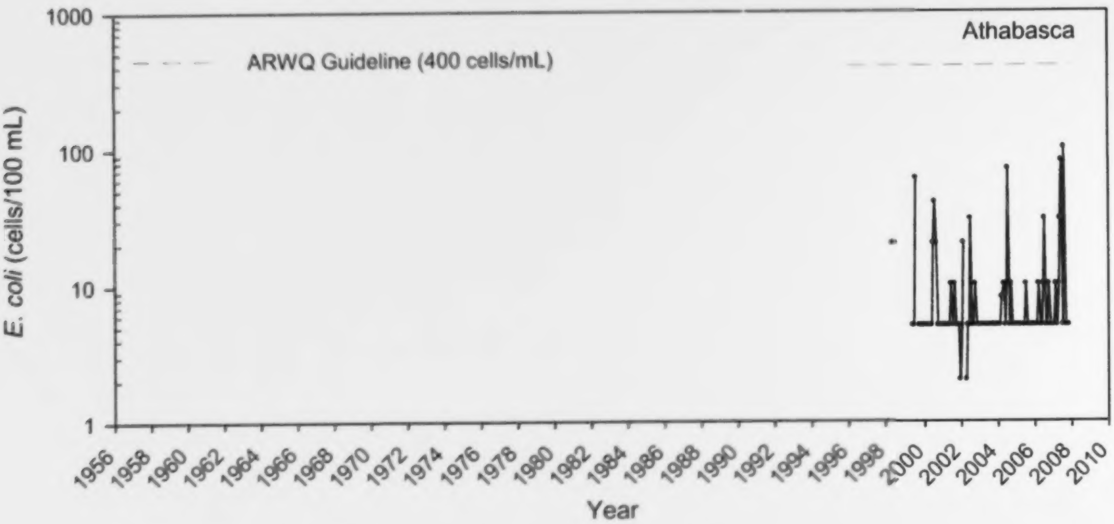
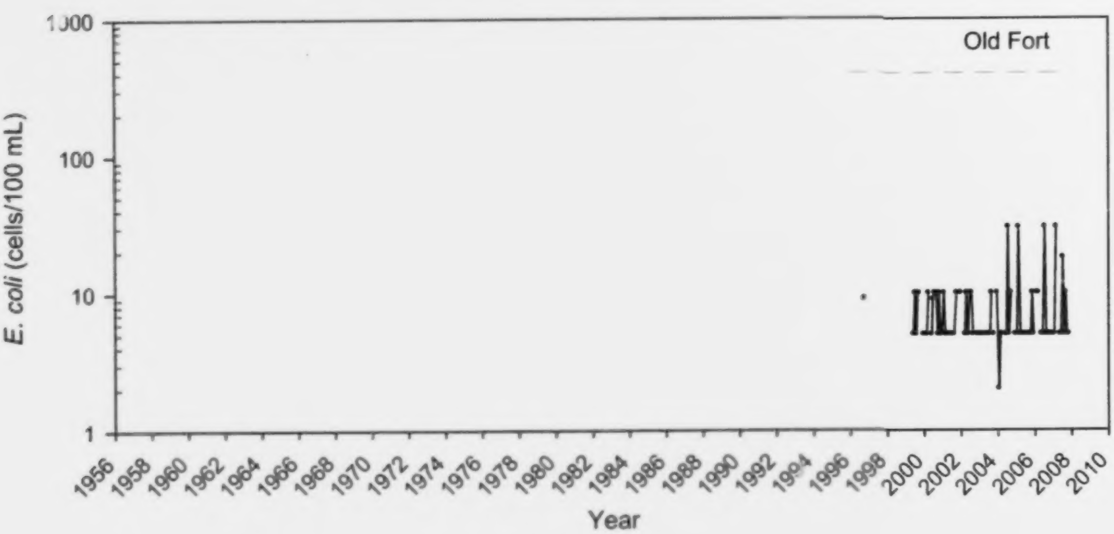


Figure 133 Seasonality of fecal coliform bacteria in the Athabasca River at Hinton and Fort McMurray. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987			Post-1987		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						5.00		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987			Post-1987		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						5.00		
Flow Adjusted								

Figure 134 *Escherichia coli* in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

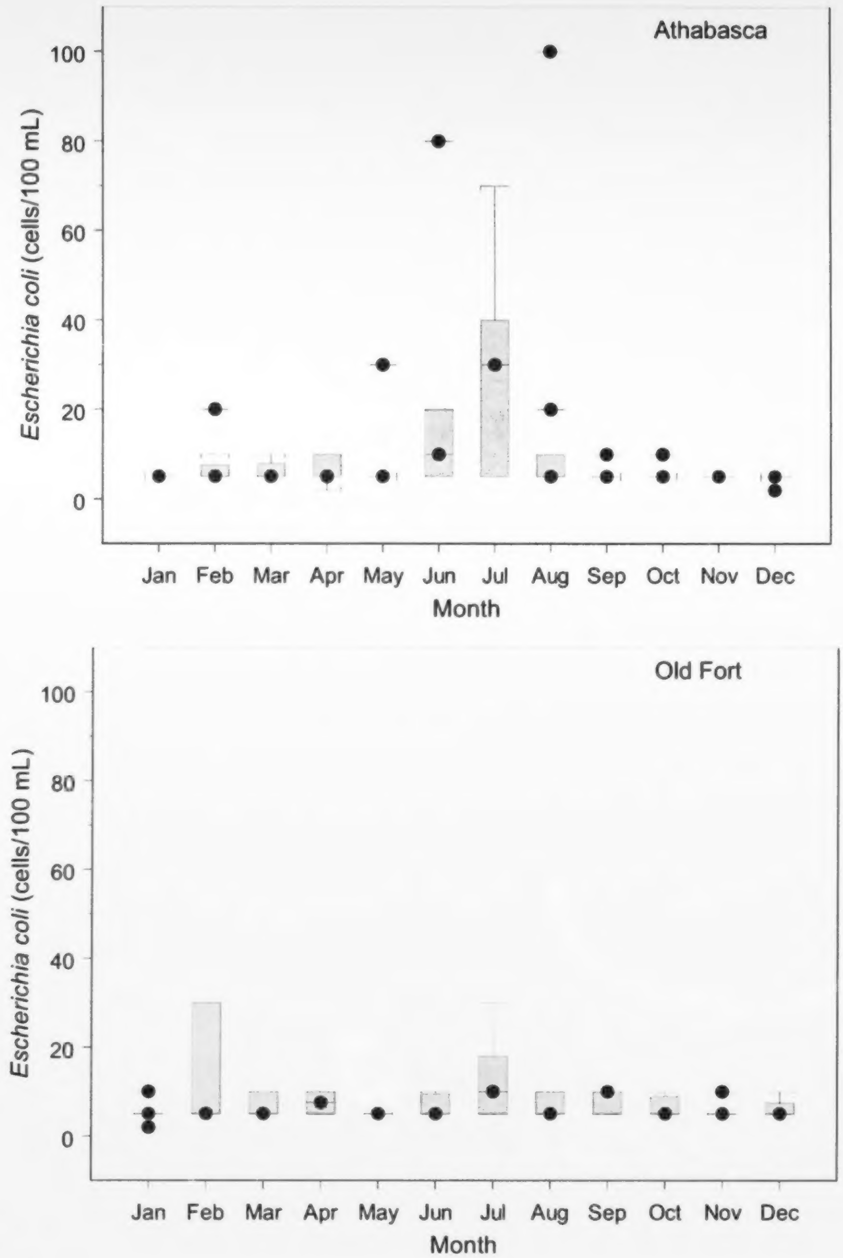
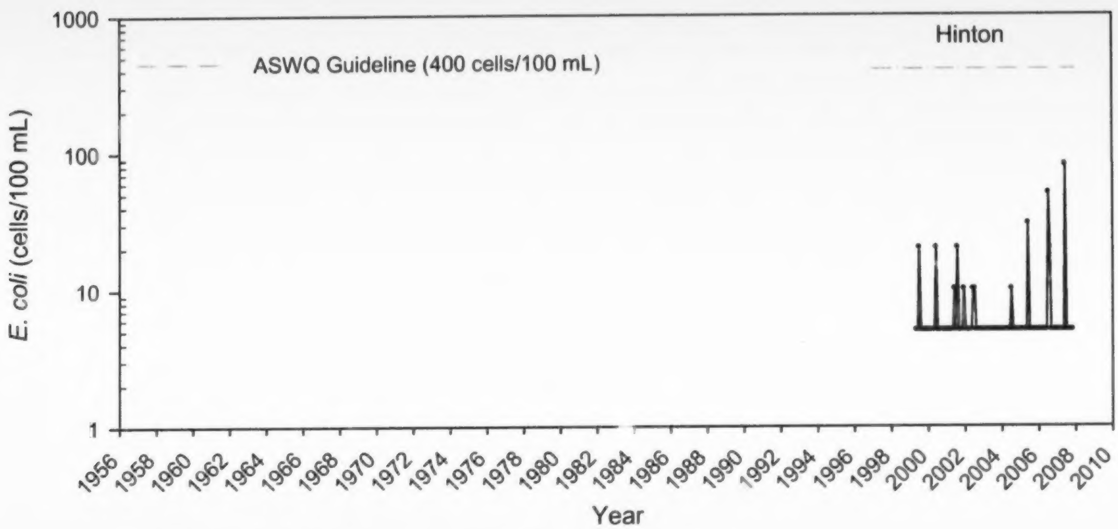
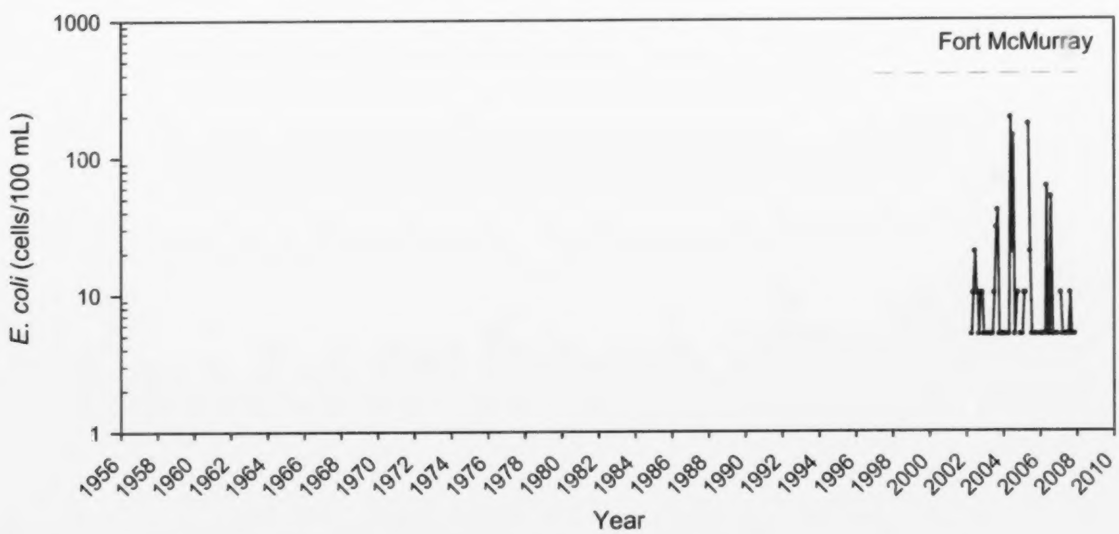


Figure 135 Seasonality of *Escherichia coli* in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						5.00		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						5.00		
Flow Adjusted								

Figure 136 *Escherichia coli* in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

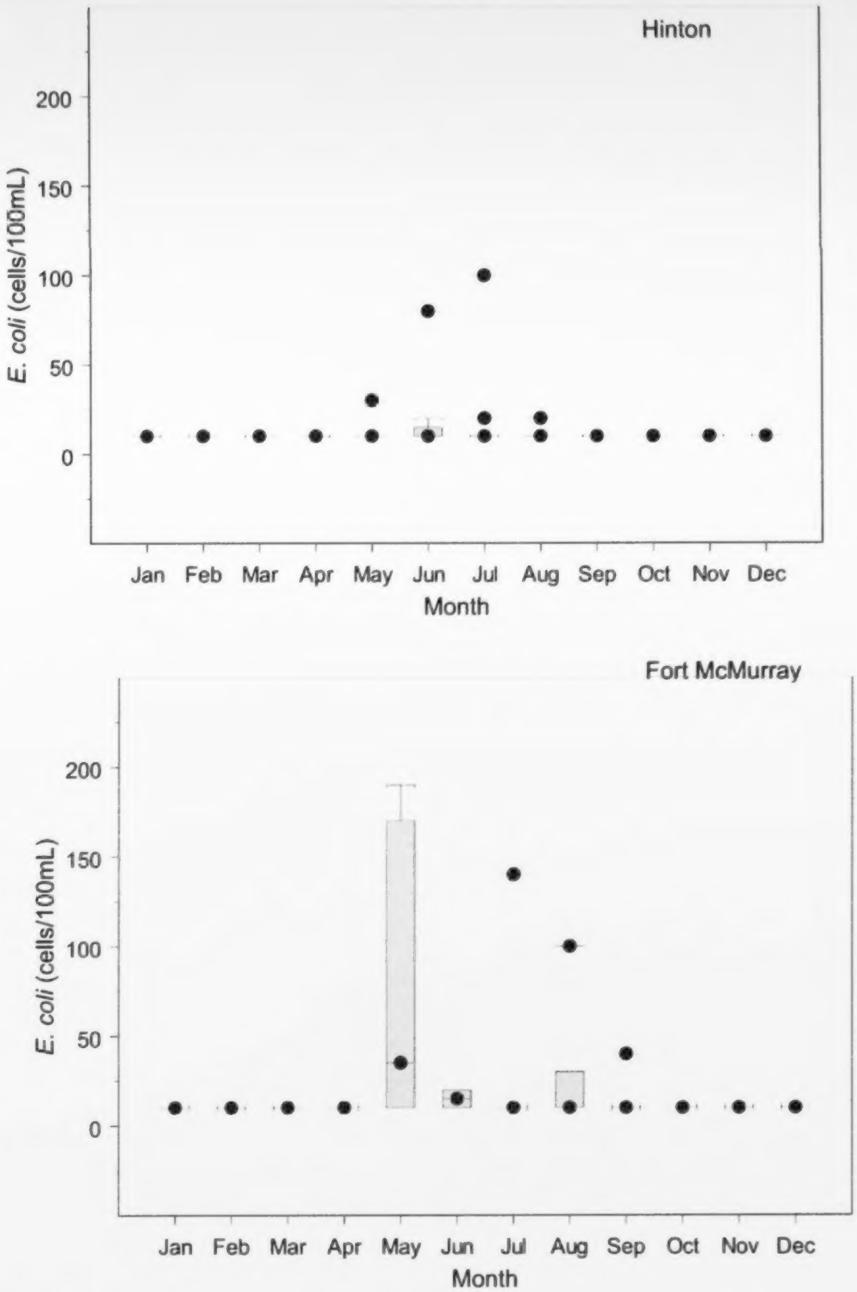
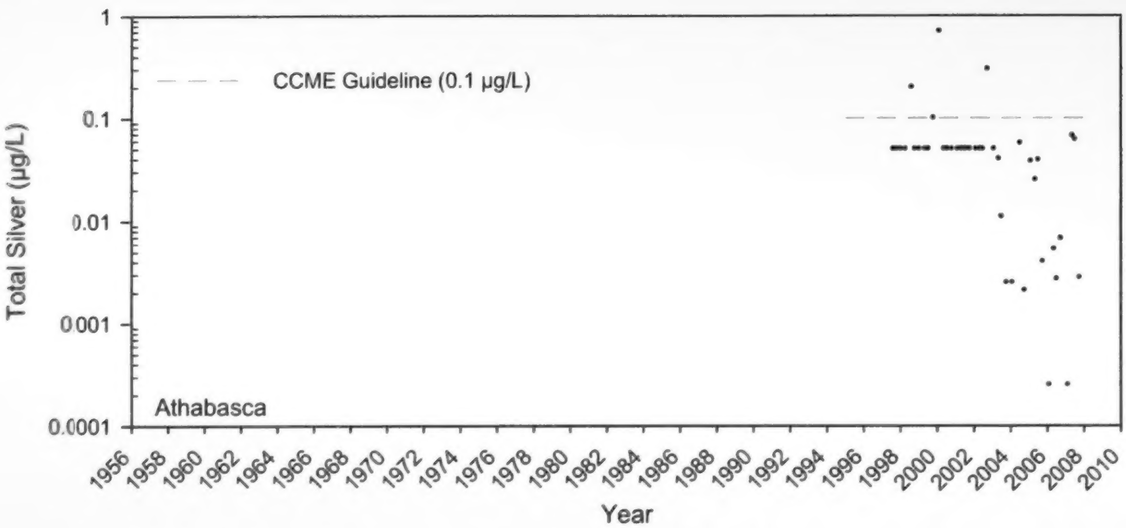
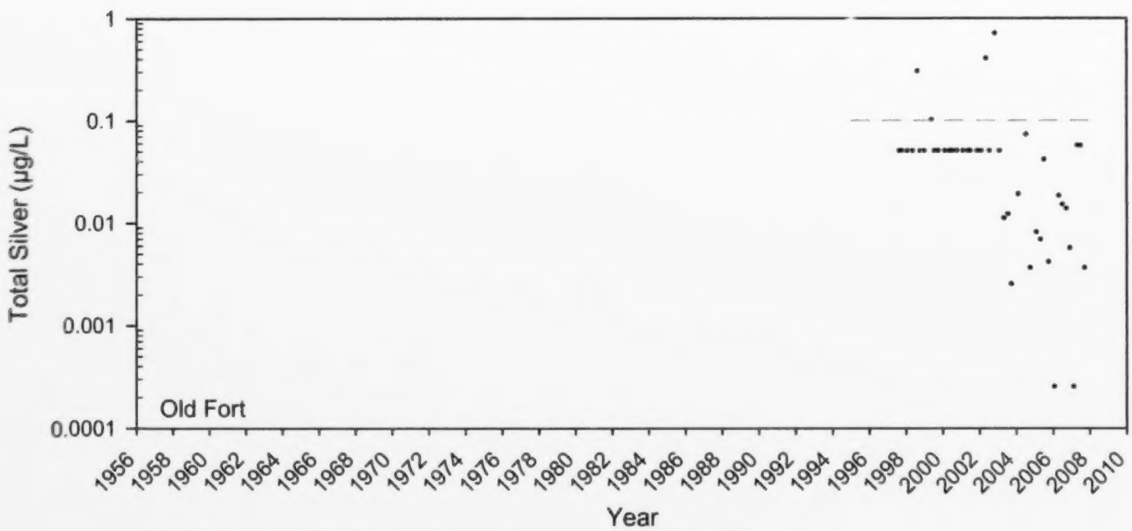


Figure 137 Seasonality of *Escherichia coli* in the Athabasca River at Hinton and Fort McMurray.

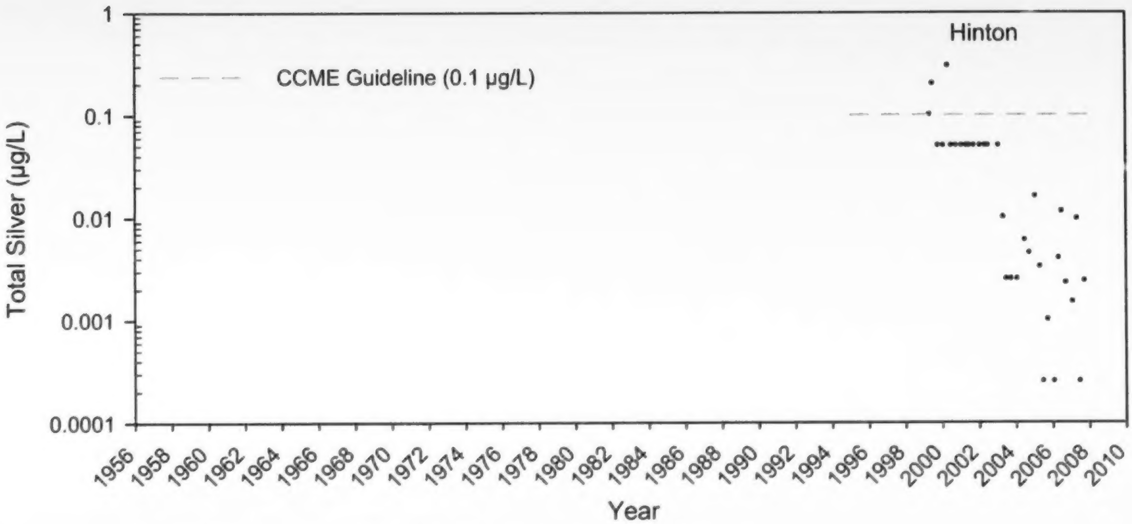


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00885		
Flow Adjusted								

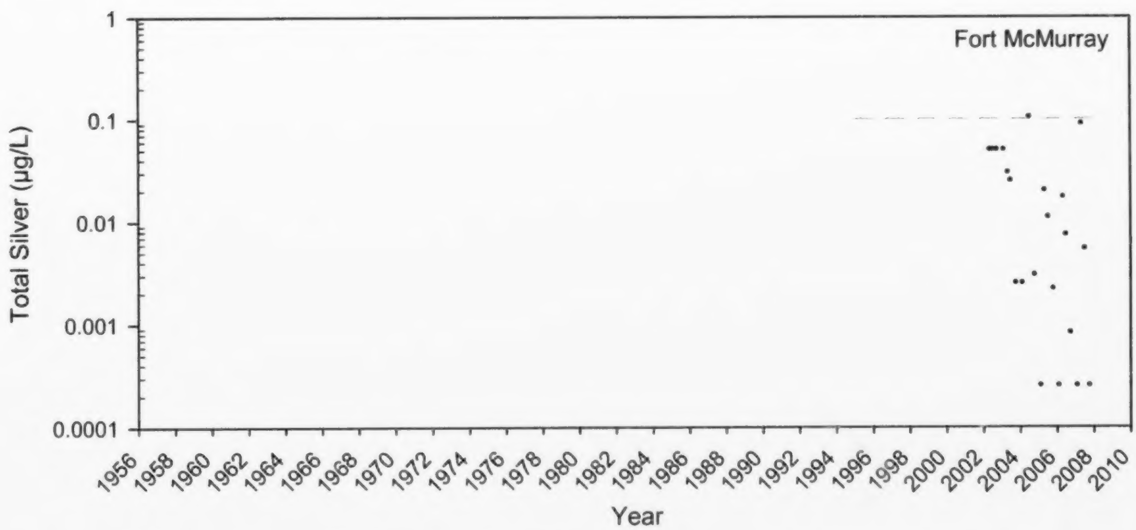


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.05230		
Flow Adjusted								

Figure 138 Total silver concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend assessment at this time.

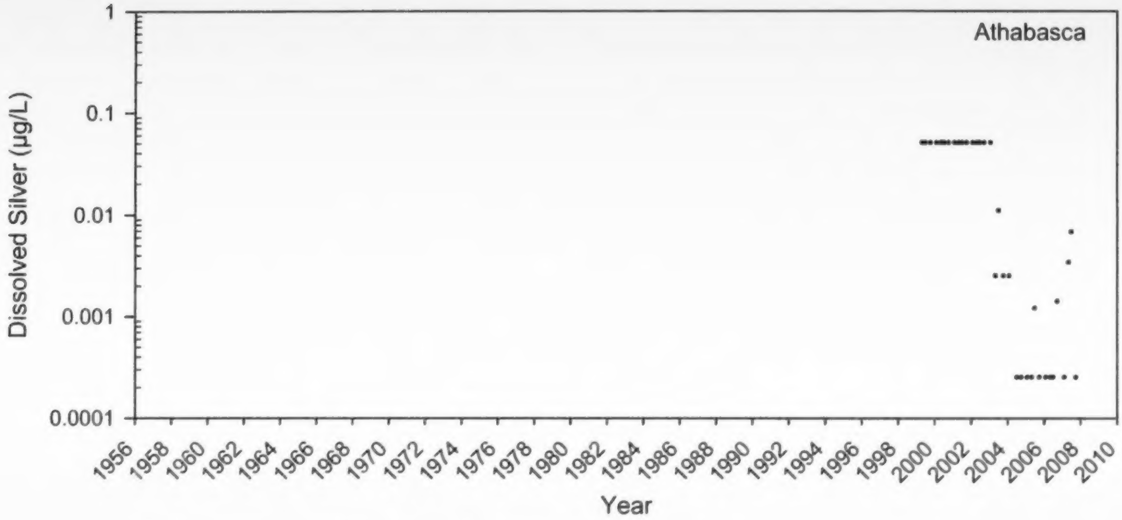


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00290		
Flow Adjusted								

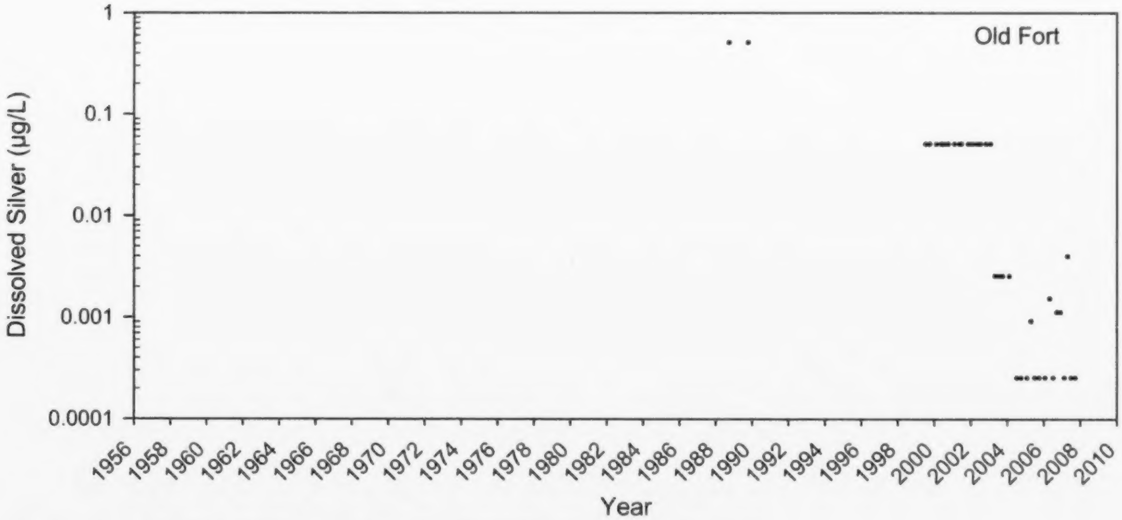


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00640		
Flow Adjusted								

Figure 139 Total silver concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

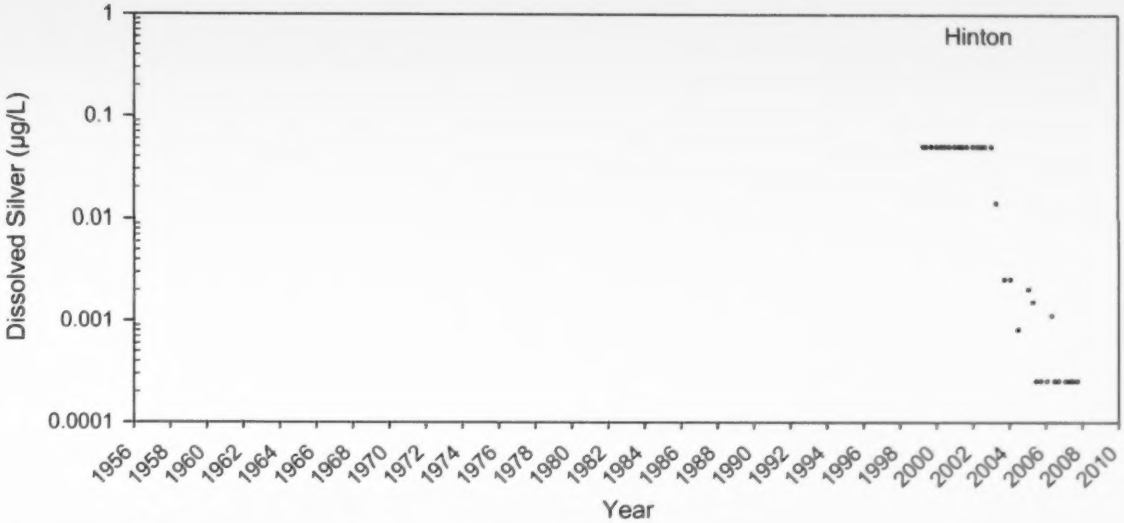


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00073		
Flow Adjusted								

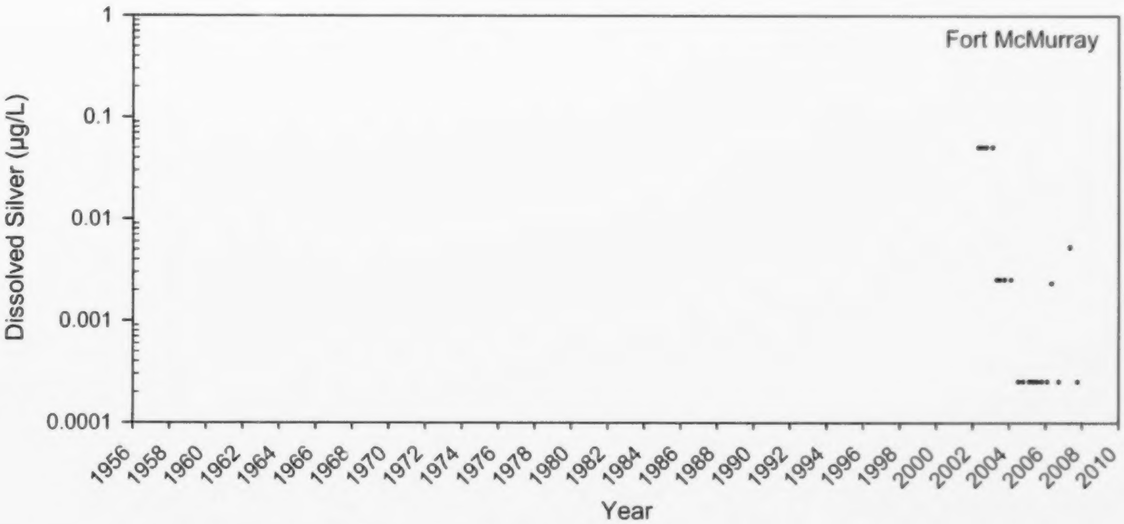


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00090		

Figure 140 Dissolved silver concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

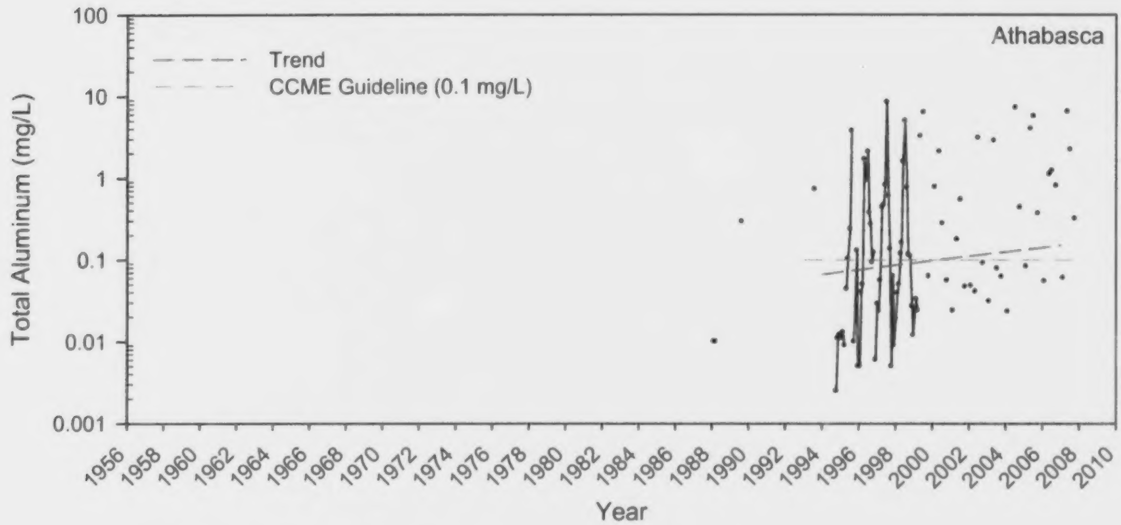


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00053		
Flow Adjusted								

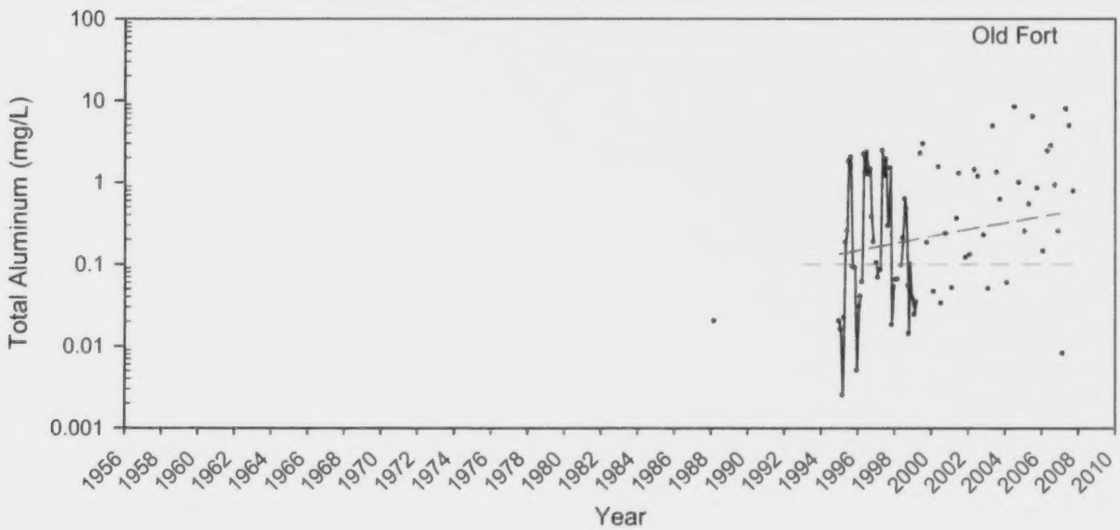


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00025		
Flow Adjusted								

Figure 141 Dissolved silver concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.1040	0.0105	up
Flow Adjusted								
							0.00812	none



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig
						0.2420	0.03100	up
Flow Adjusted								
							0.05544	up

Figure 142 Total aluminum concentration in the Athabasca River at Athabasca and Old Fort. Significance of monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$).

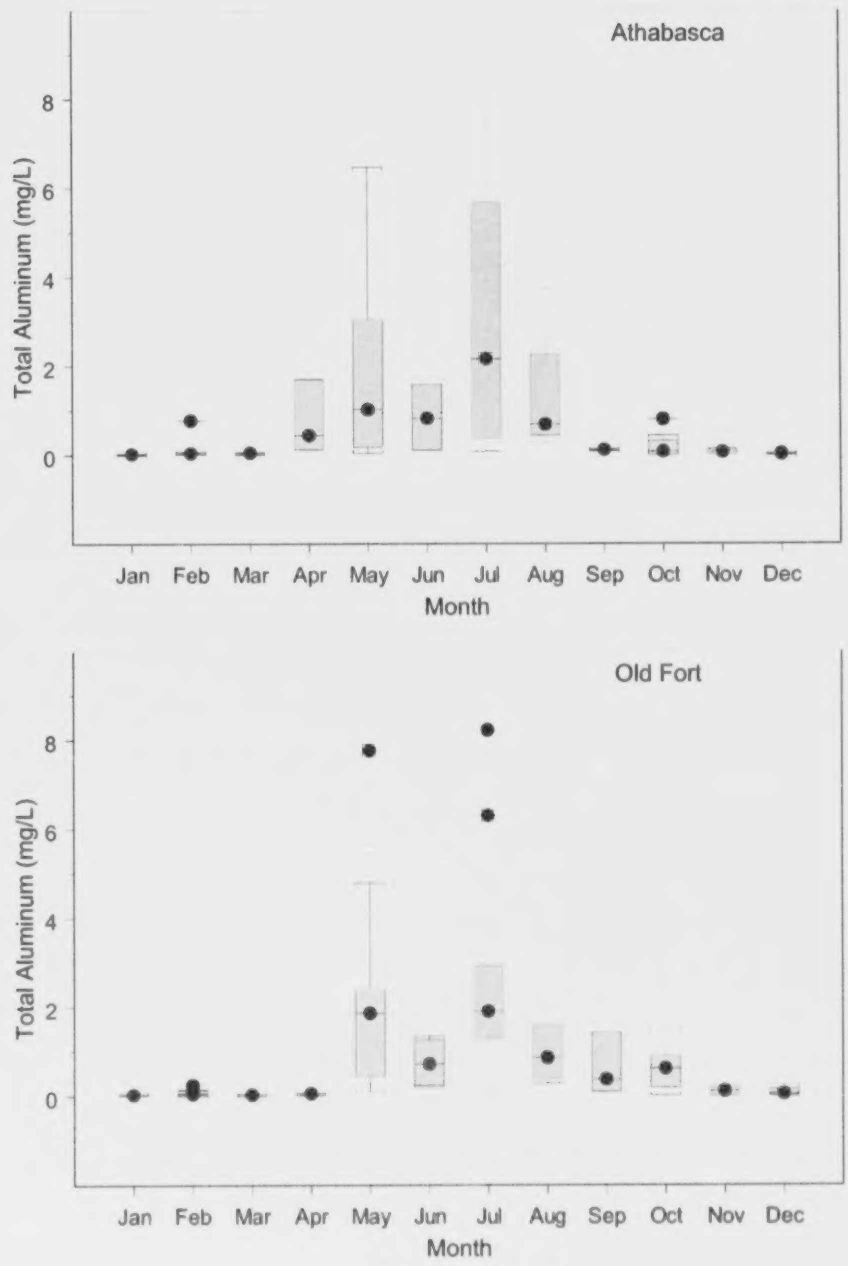
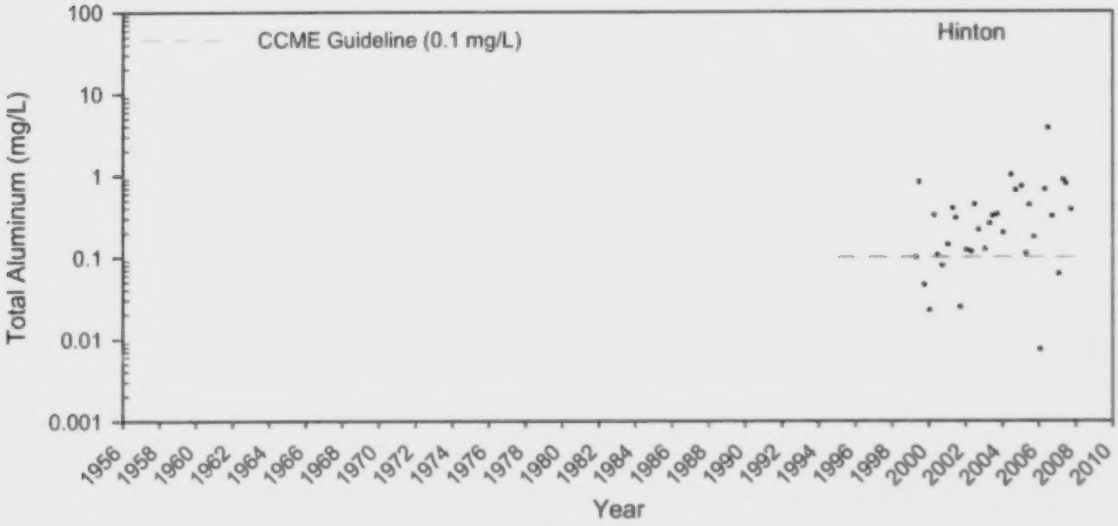
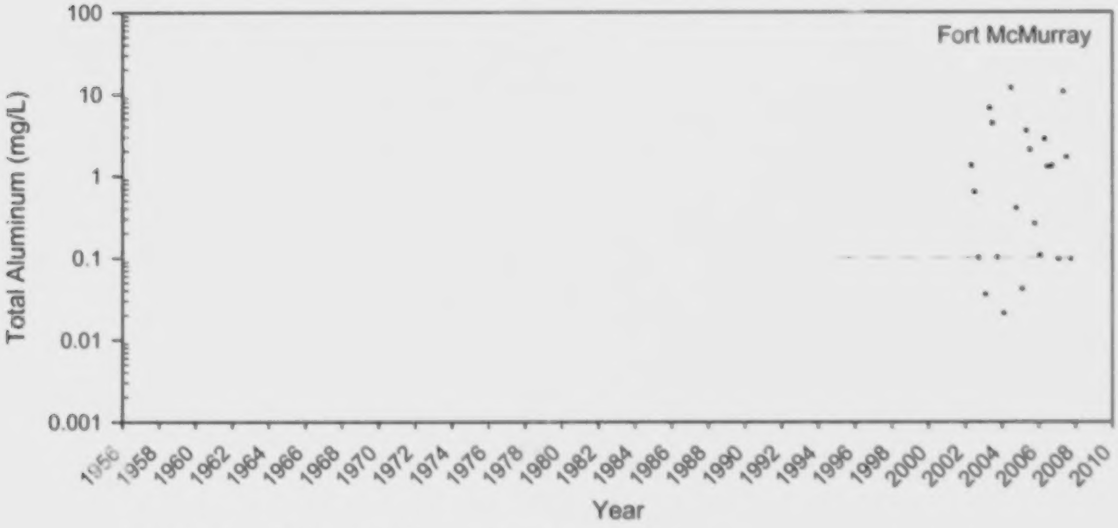


Figure 143 Seasonality of total aluminum in the Athabasca River at Athabasca and Old Fort.

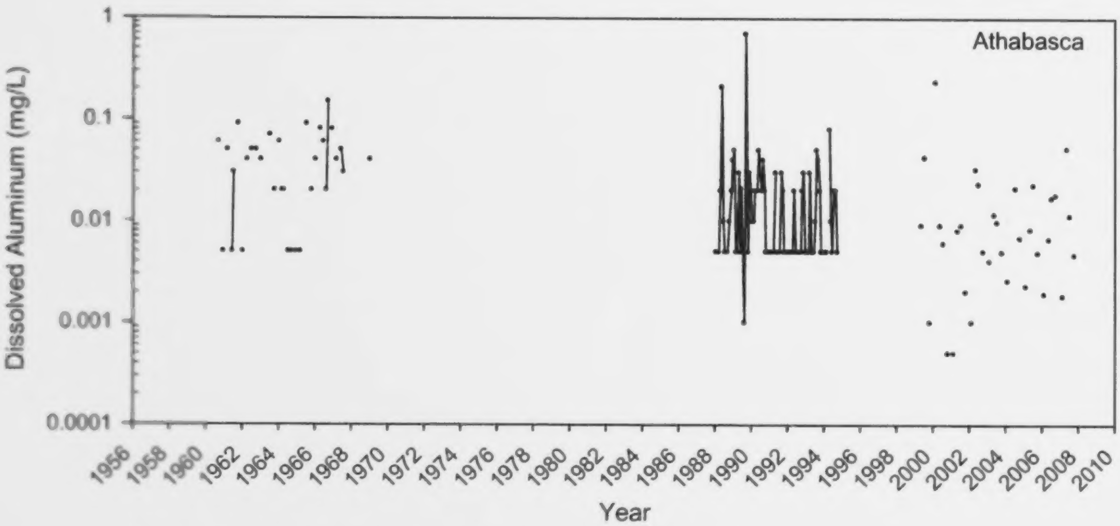


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.2930		
Flow Adjusted								

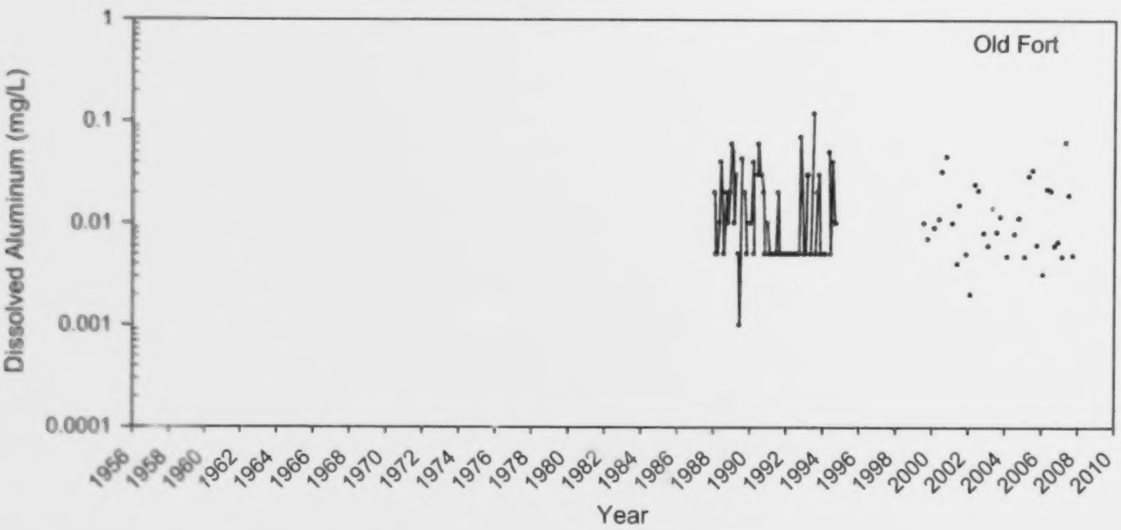


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.9400		
Flow Adjusted								

Figure 144 Total aluminum concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

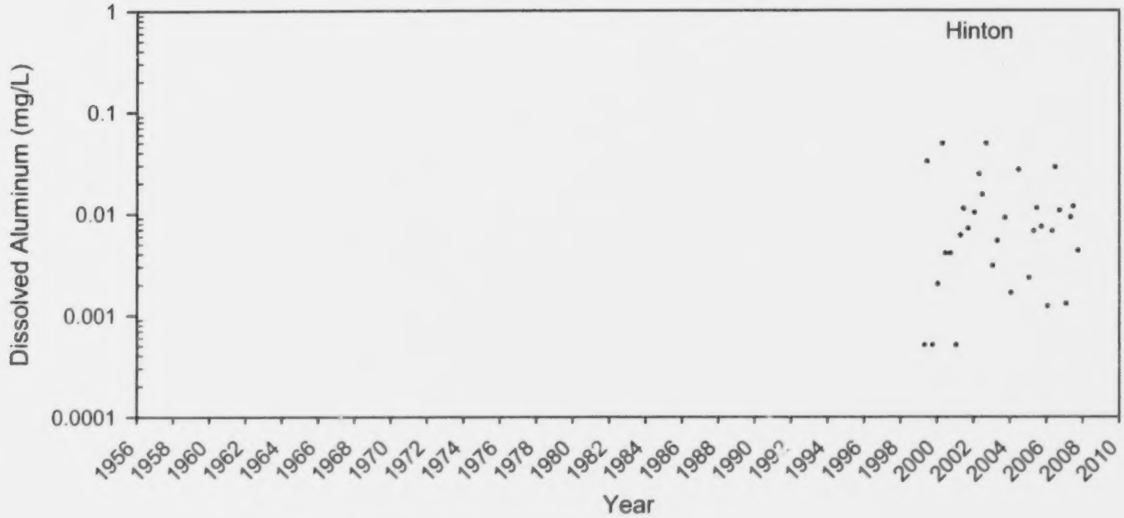


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00739		
Flow Adjusted								

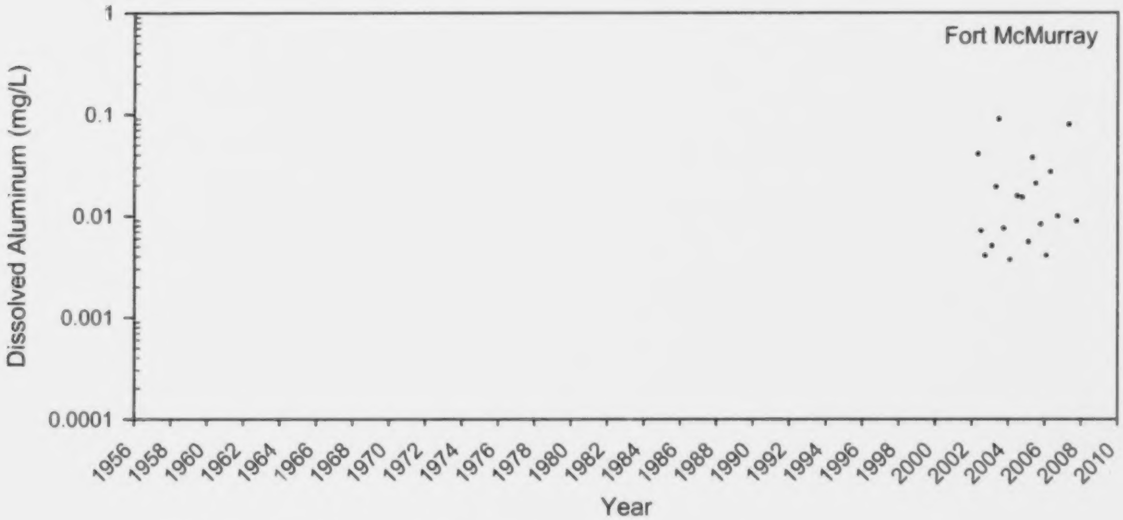


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00950		
Flow Adjusted								

Figure 145 Dissolved aluminum concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00700		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00976		
Flow Adjusted								

Figure 146 Dissolved aluminum in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

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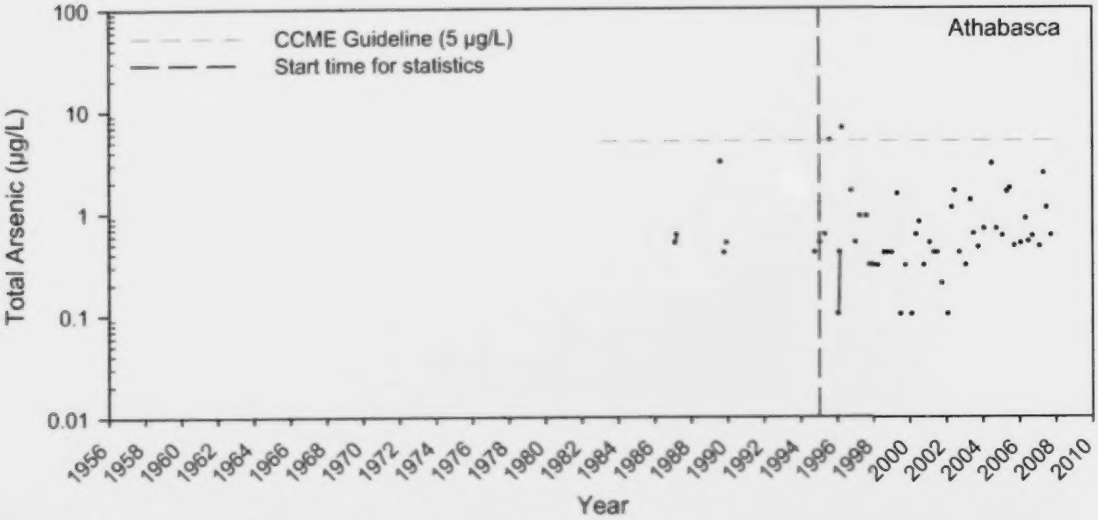
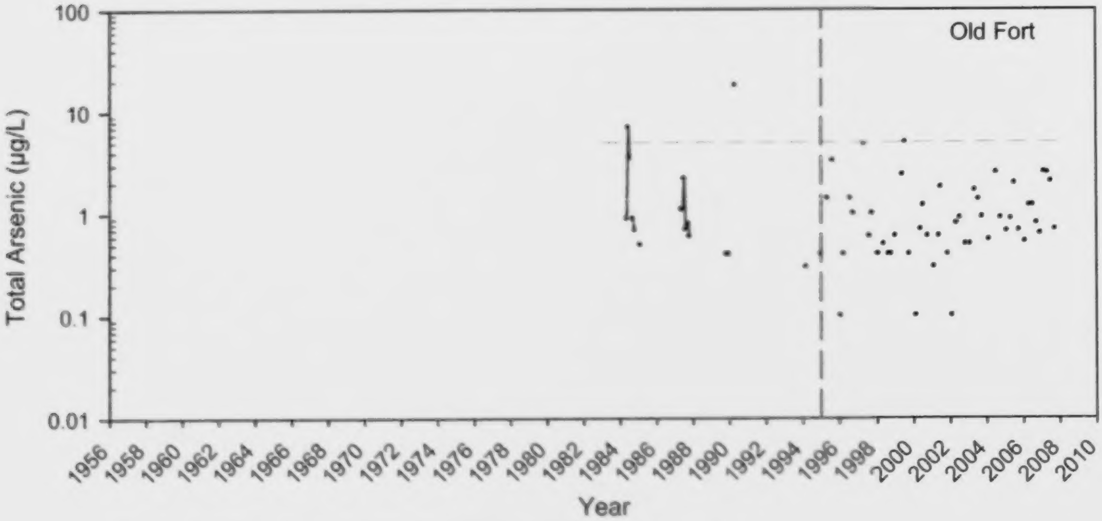


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.5050	0.02543	none
Flow Adjusted								
							0.00689	none



Overall Trend		1987 Step Trend	Pre-1987			Post-1987		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.7500	0.04330	none
Flow Adjusted								
							0.04719	up

Figure 147 Total arsenic concentration in the Athabasca River at Athabasca and Old Fort. Significance of monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). Hashed vertical line represents begin of analysed data.

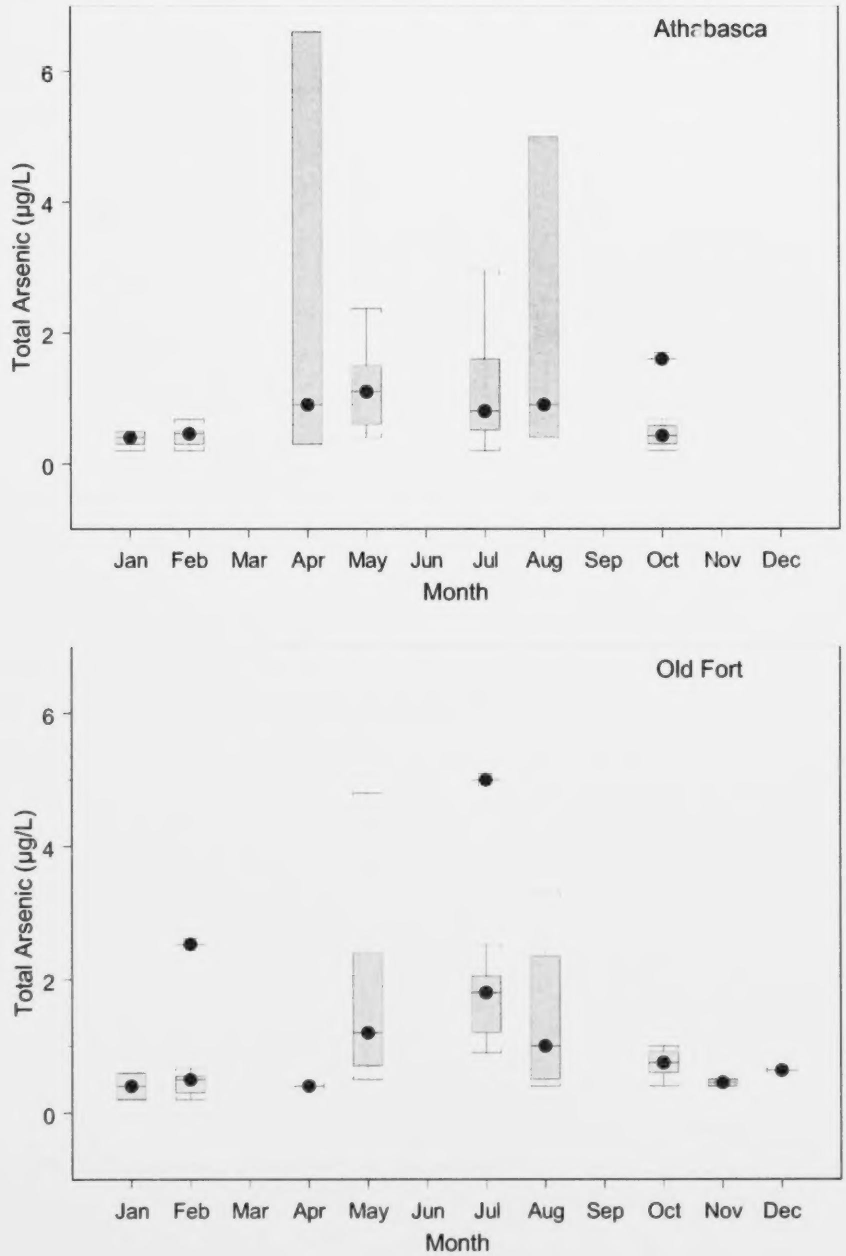
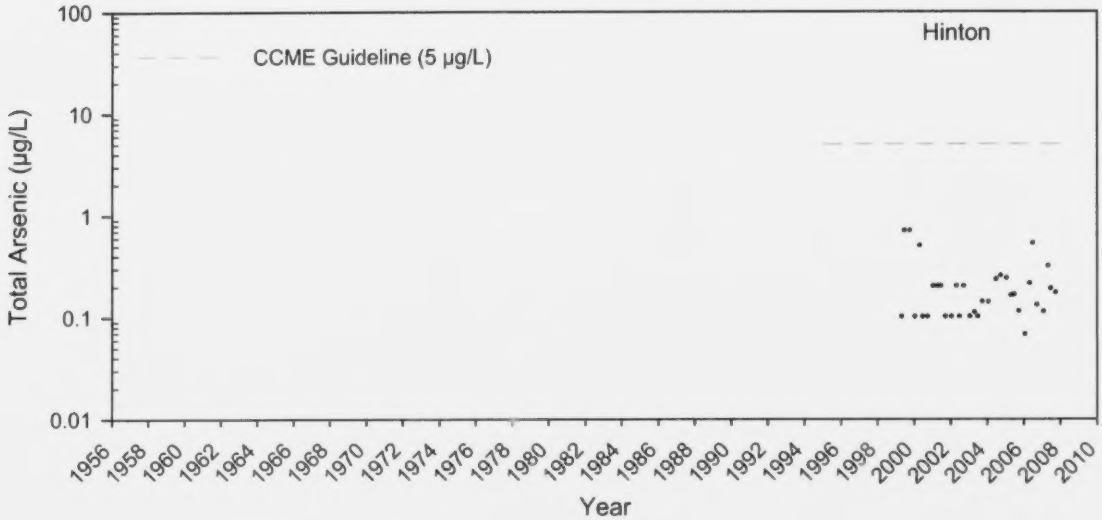
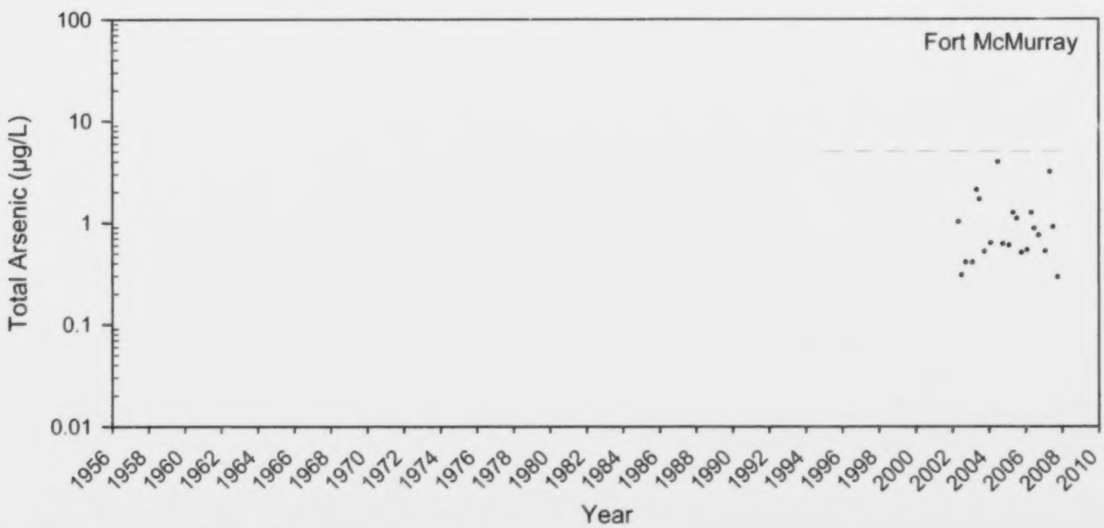


Figure 148 Seasonality of total arsenic in the Athabasca River at Athabasca and Old Fort.

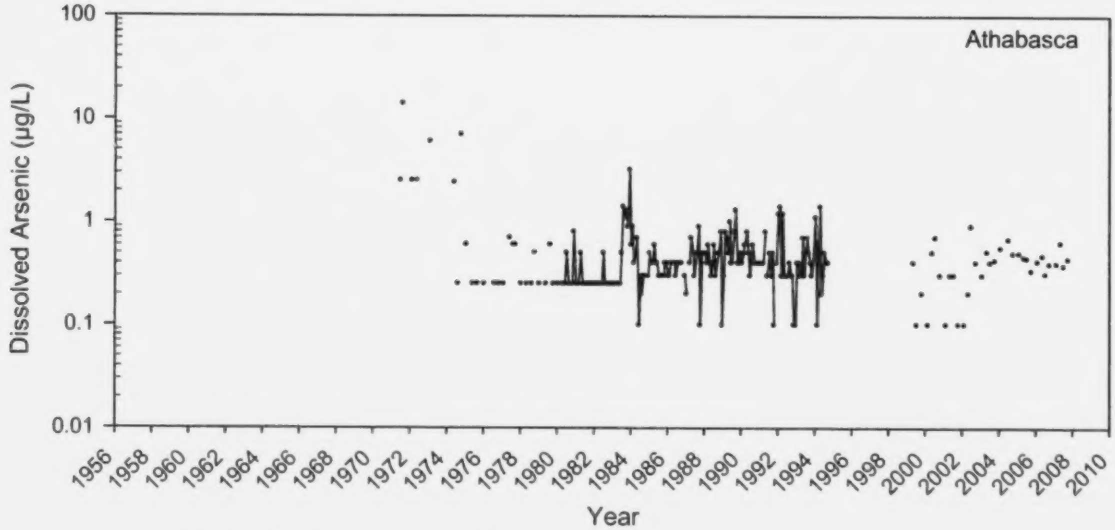


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.1650		
Flow Adjusted								

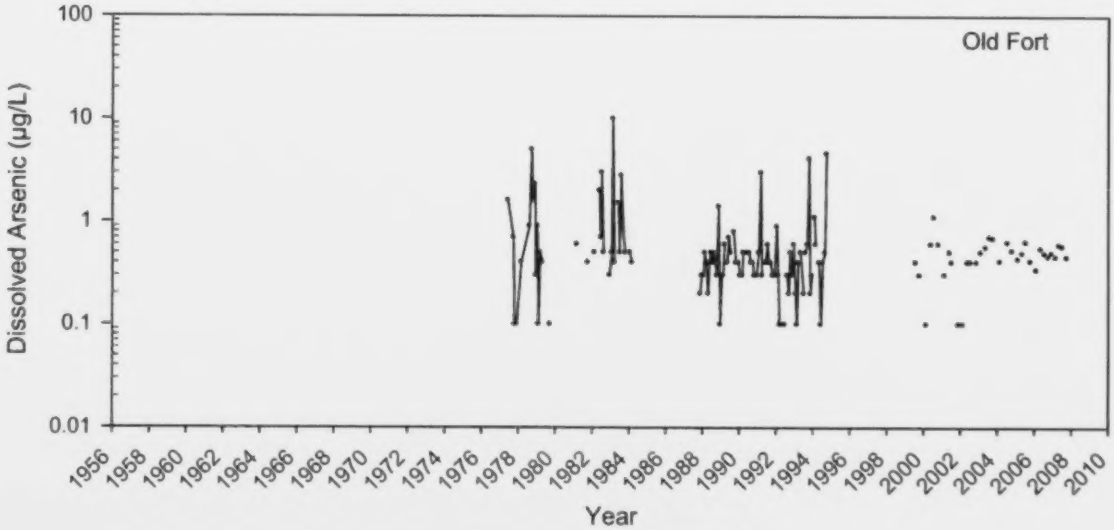


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.6785		
Flow Adjusted								

Figure 149 Total arsenic concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

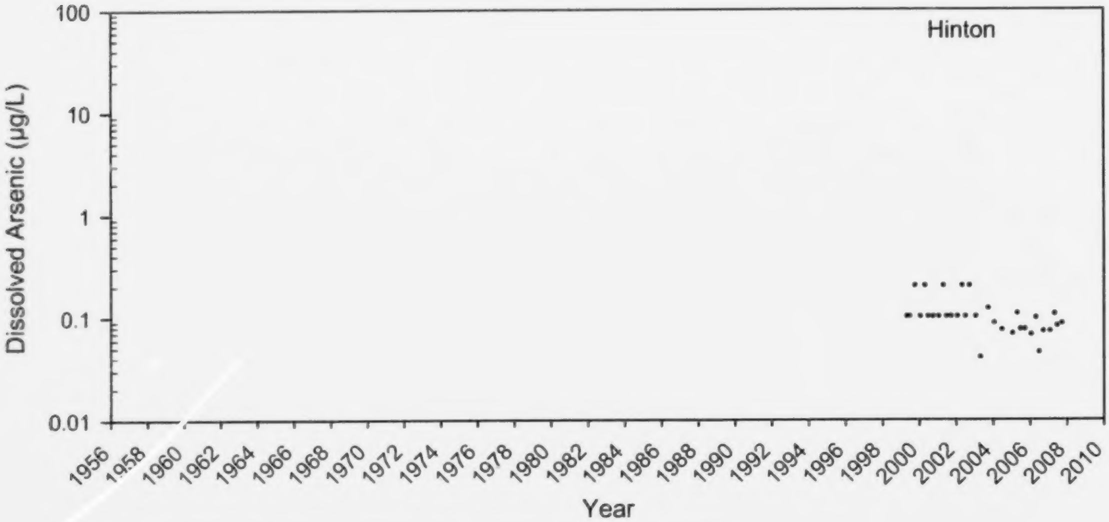


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.4000		
Flow Adjusted								

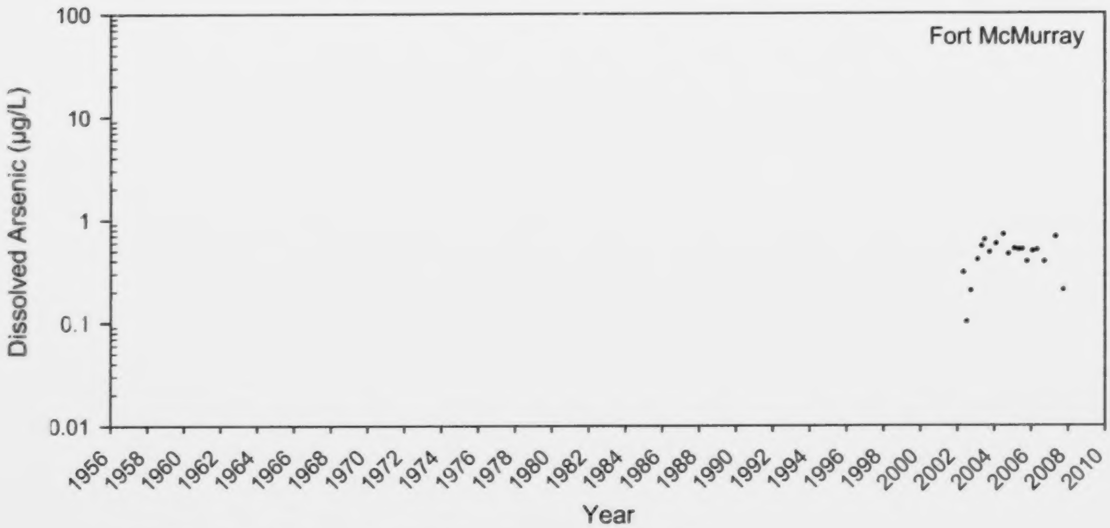


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.4730		
Flow Adjusted								

Figure 150 Dissolved arsenic concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.1000		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.4830		
Flow Adjusted								

Figure 151 Dissolved arsenic concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

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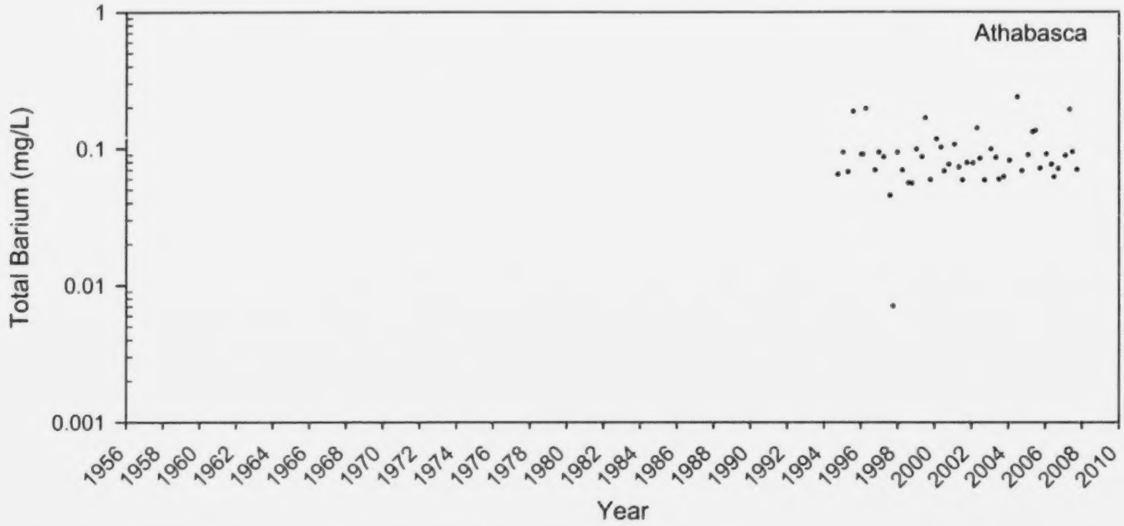
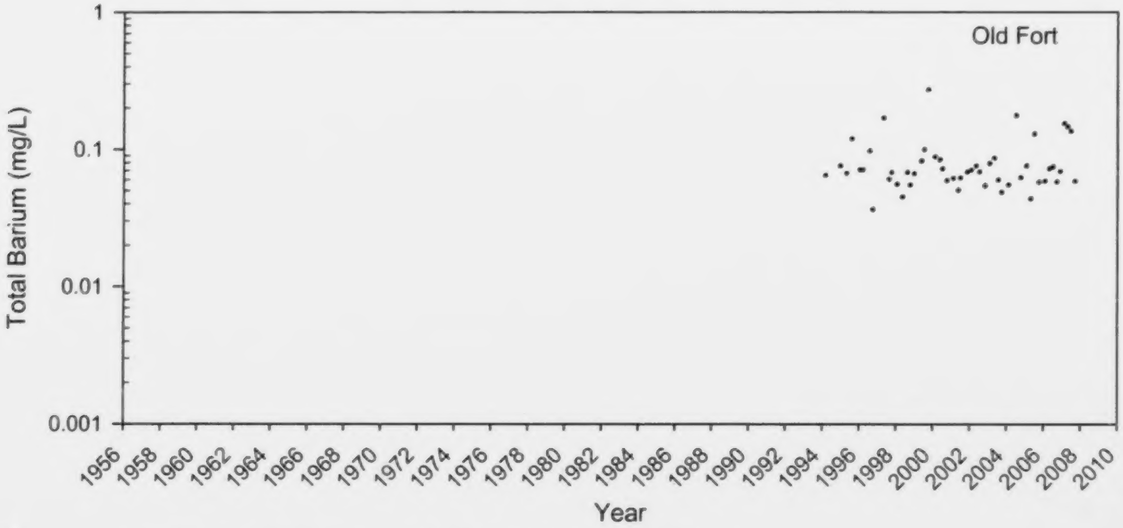


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0838	0.00071	none
Flow Adjusted								
							0.00030	none



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.06770	0.00058	none
Flow Adjusted								
							0.00107	none

Figure 152 Total barium concentration in the Athabasca River at Athabasca and Old Fort. Significance of monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$).

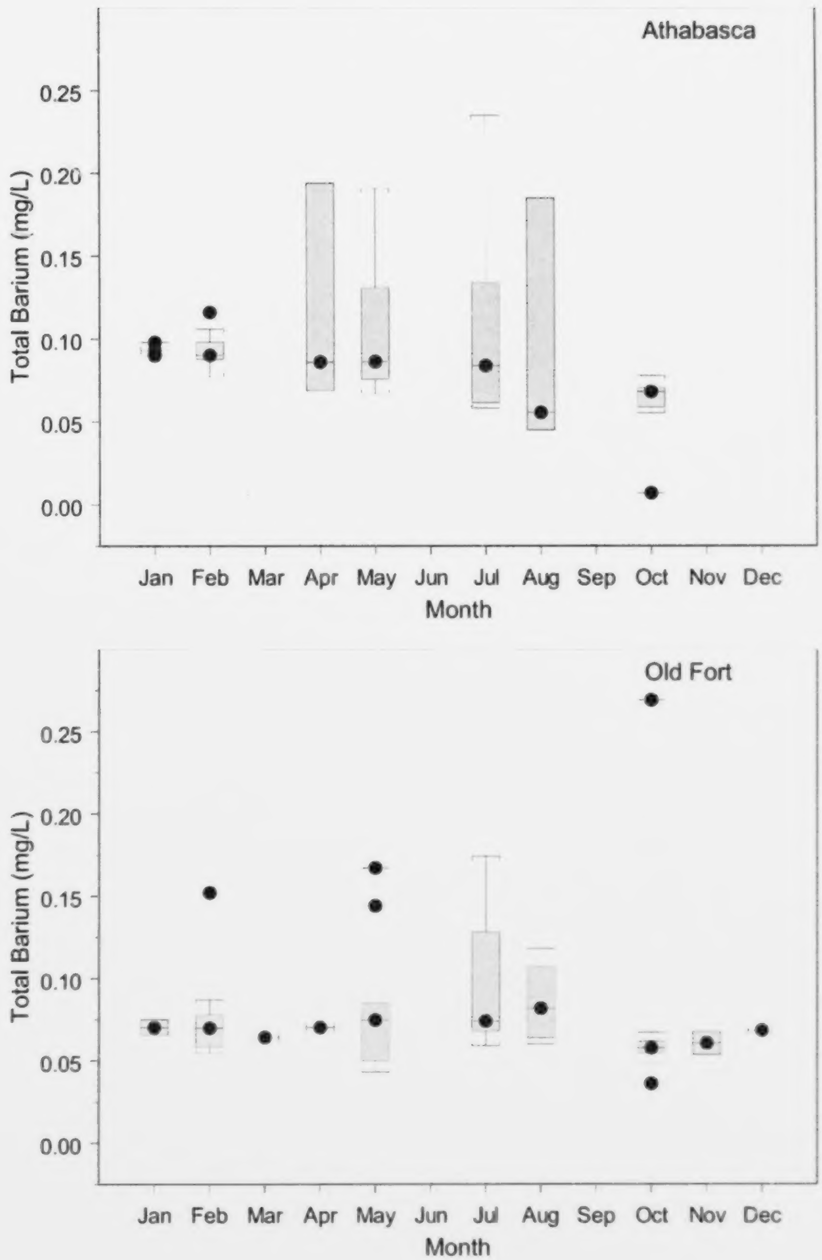
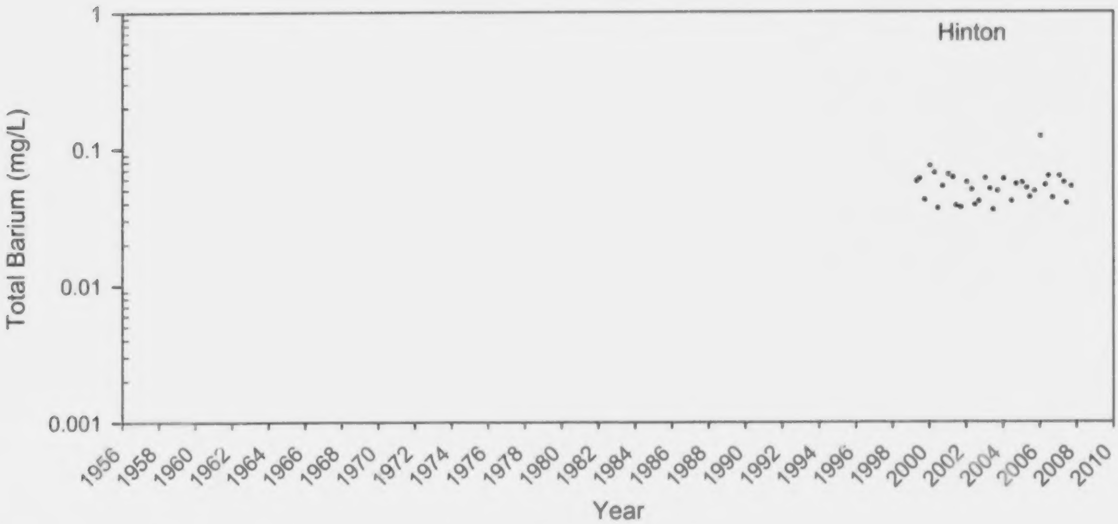
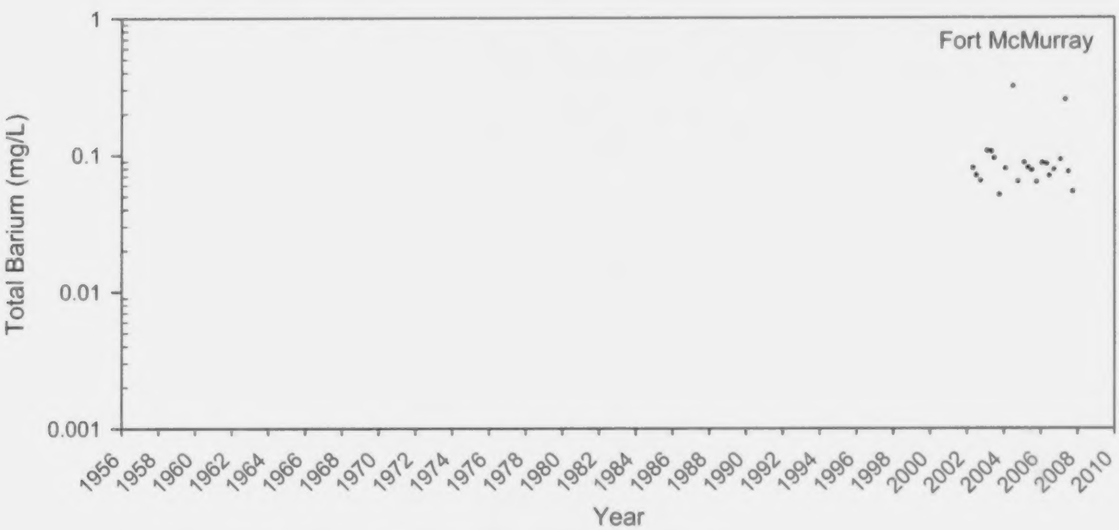


Figure 153 Seasonality of total barium in the Athabasca at Athabasca and Old Fort.

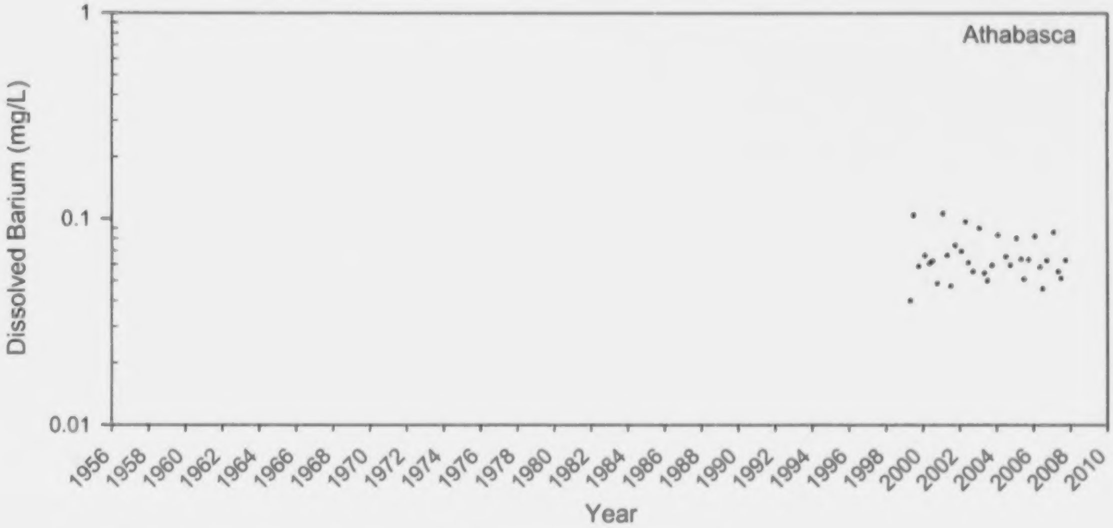


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0519		
Flow Adjusted								

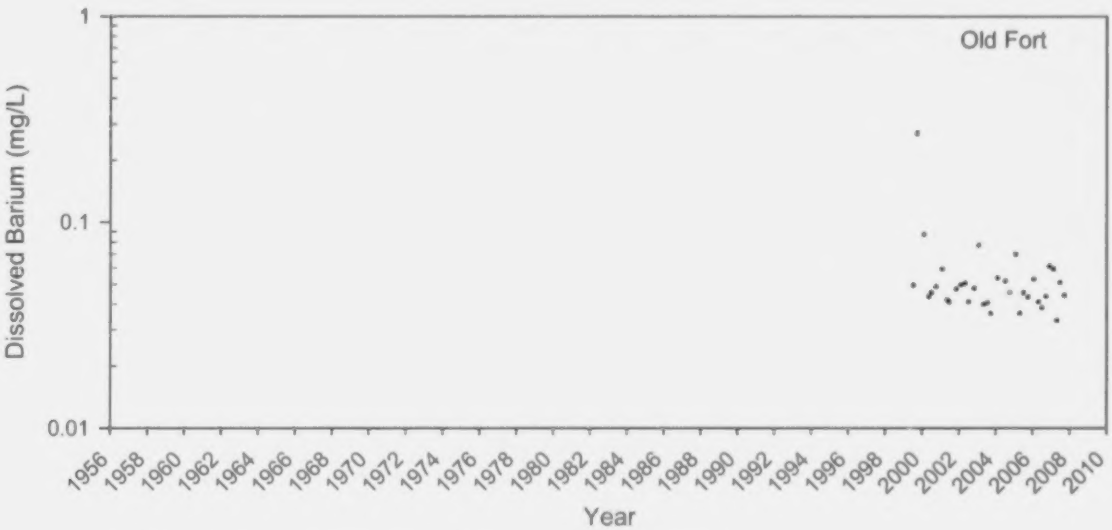


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0782		
Flow Adjusted								

Figure 154 Total barium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

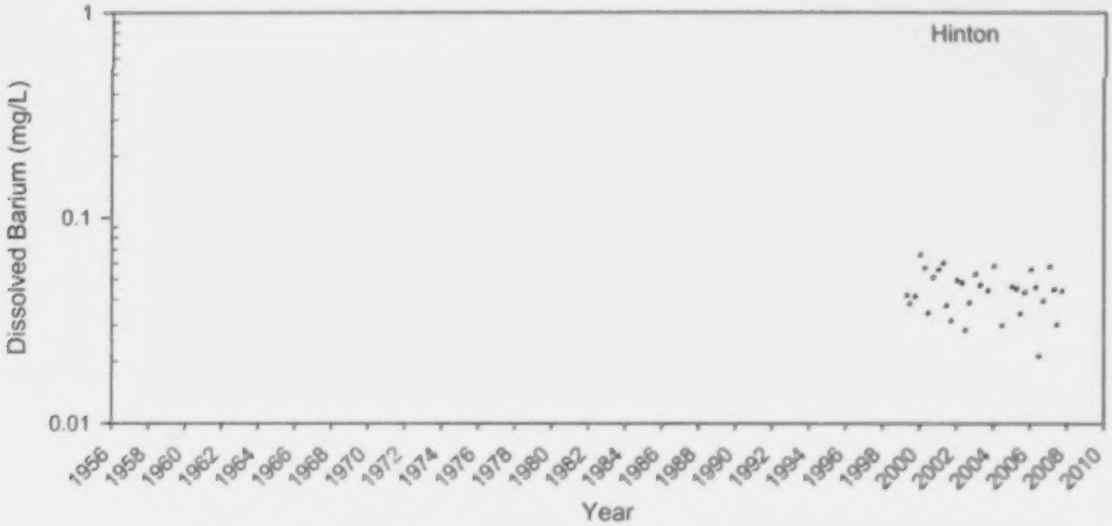


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0620		
Flow Adjusted								

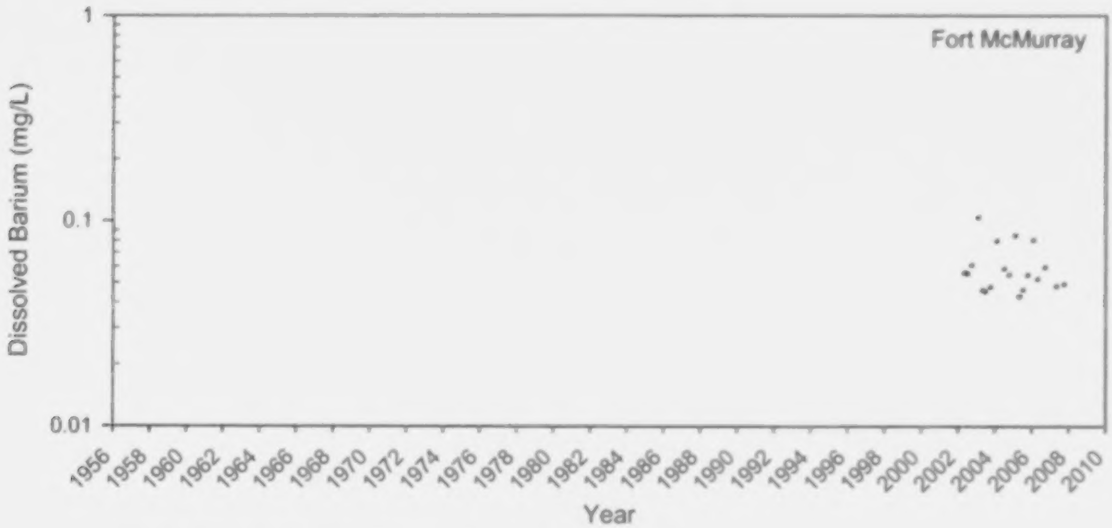


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0461		
Flow Adjusted								

Figure 155 Dissolved barium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

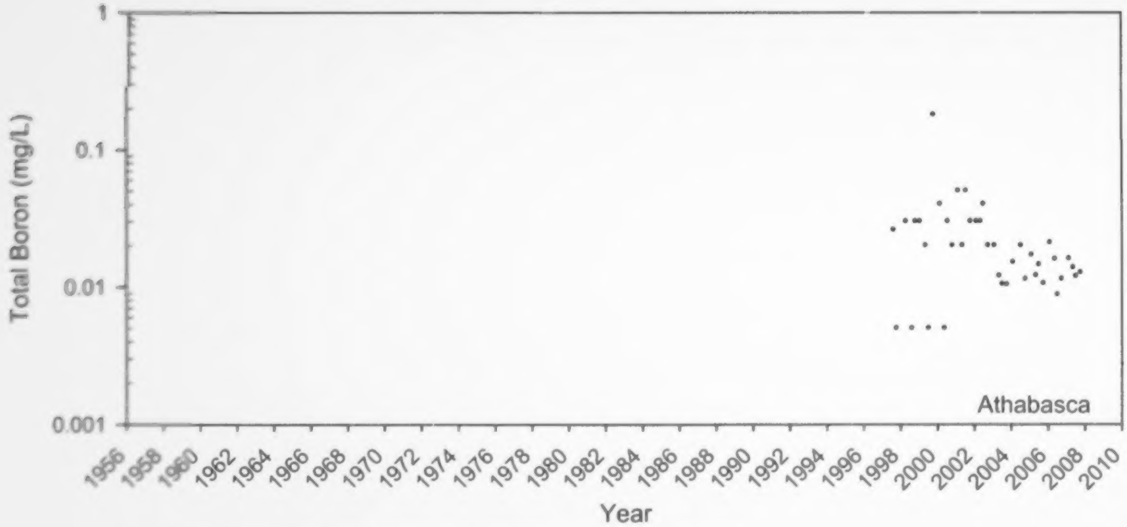


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0444		
Flow Adjusted								

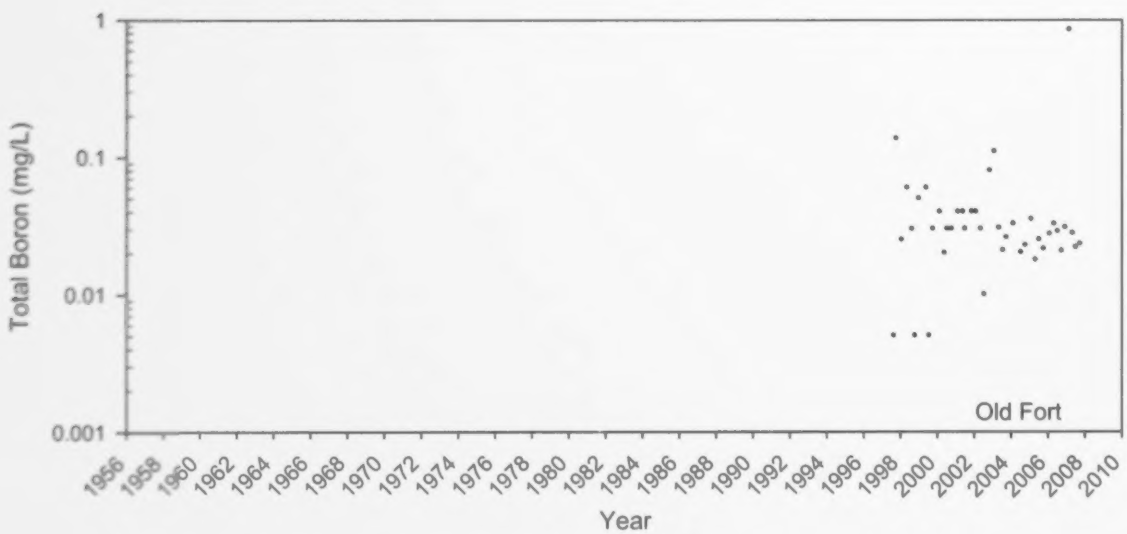


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0542		
Flow Adjusted								

Figure 156 Dissolved barium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

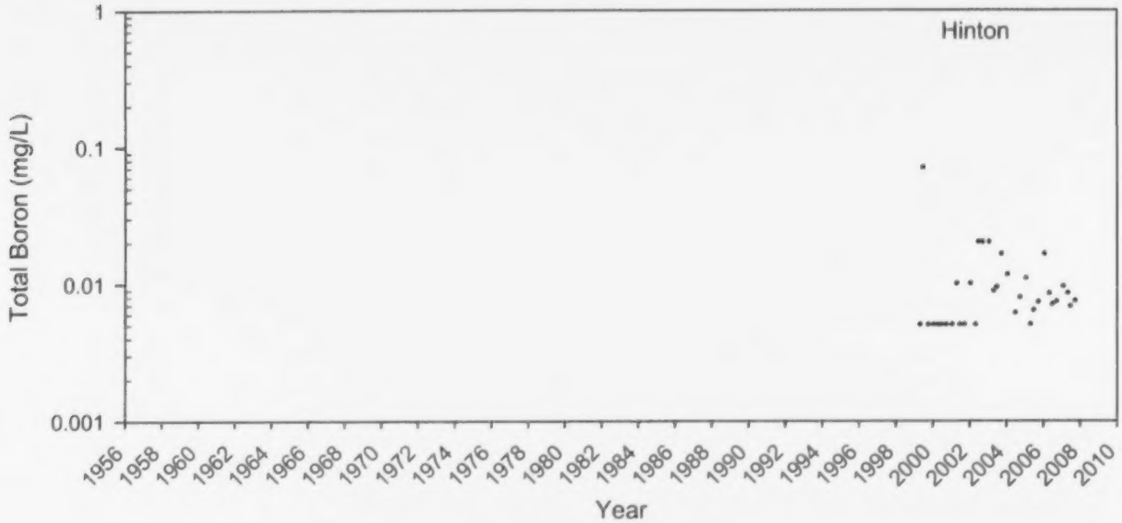


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0186		
Flow Adjusted								

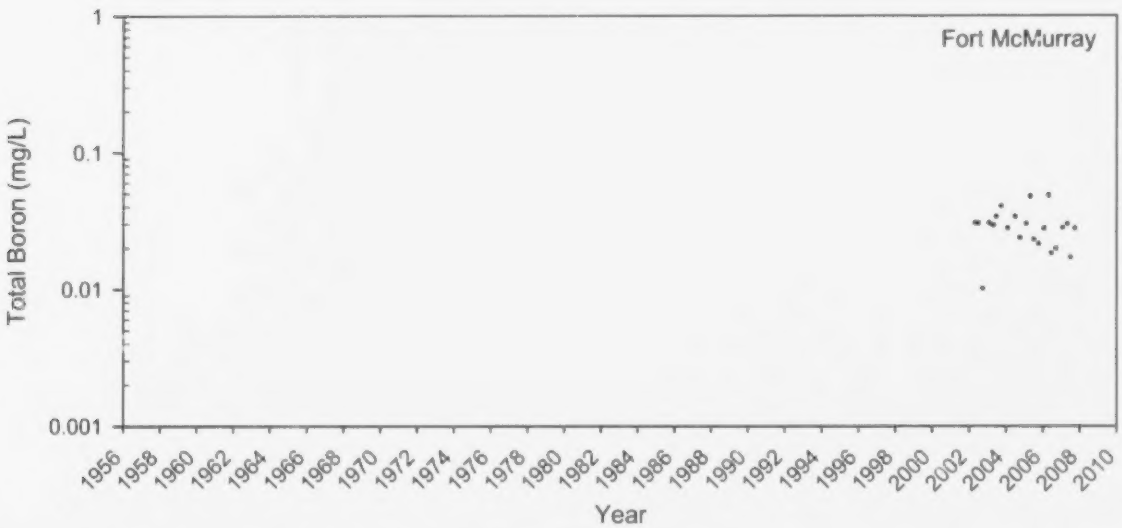


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0300		
Flow Adjusted								

Figure 157 Total boron concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

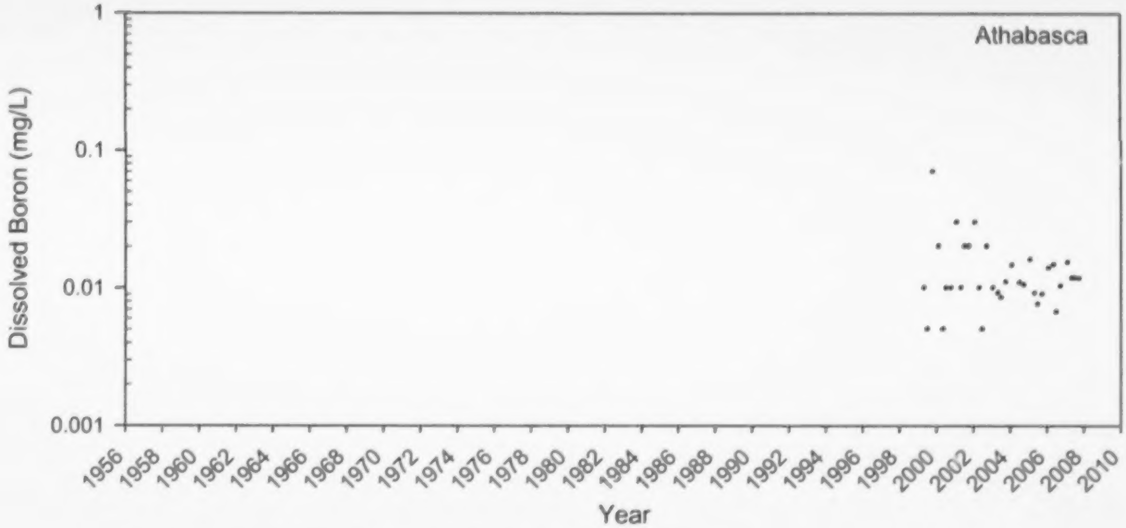


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.00746		
Flow Adjusted								

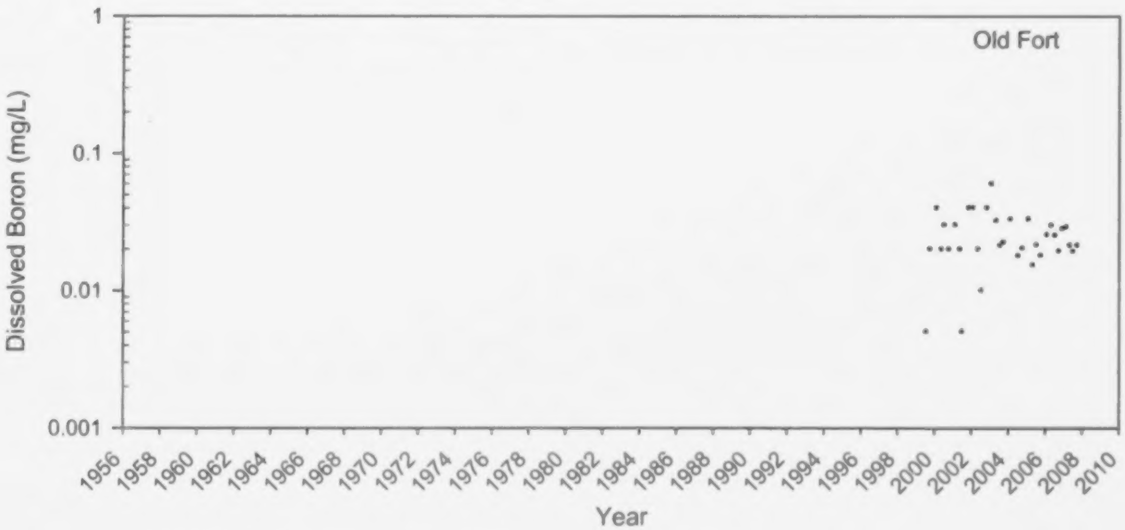


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.02840		
Flow Adjusted								

Figure 158 Total boron concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

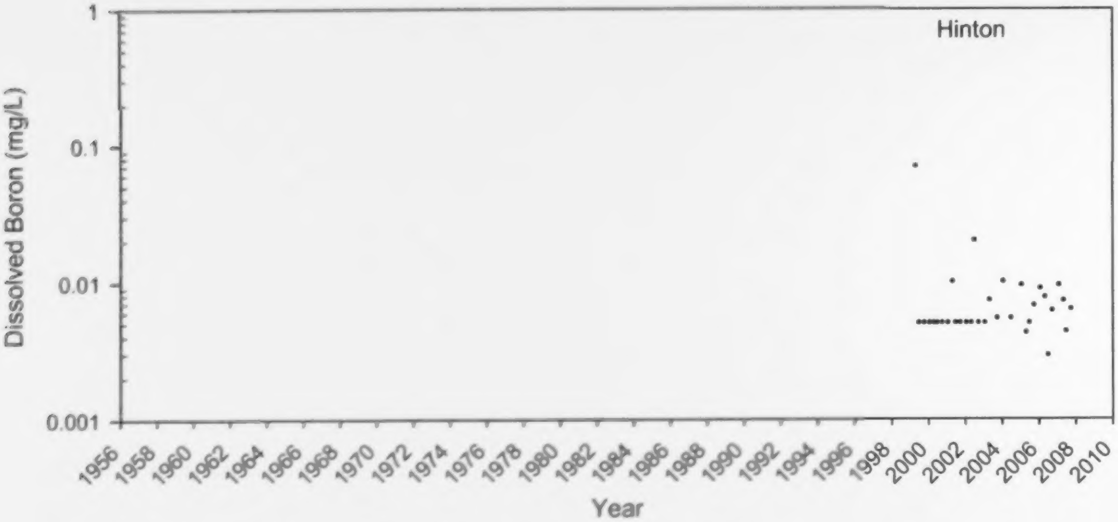


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0107		
Flow Adjusted								

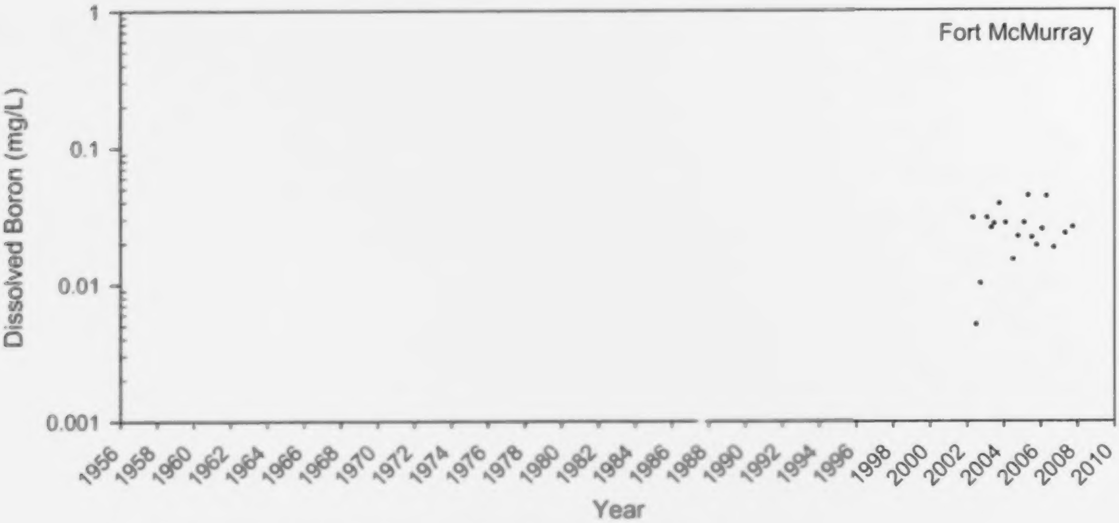


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0214		
Flow Adjusted								

Figure 159 Dissolved boron concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

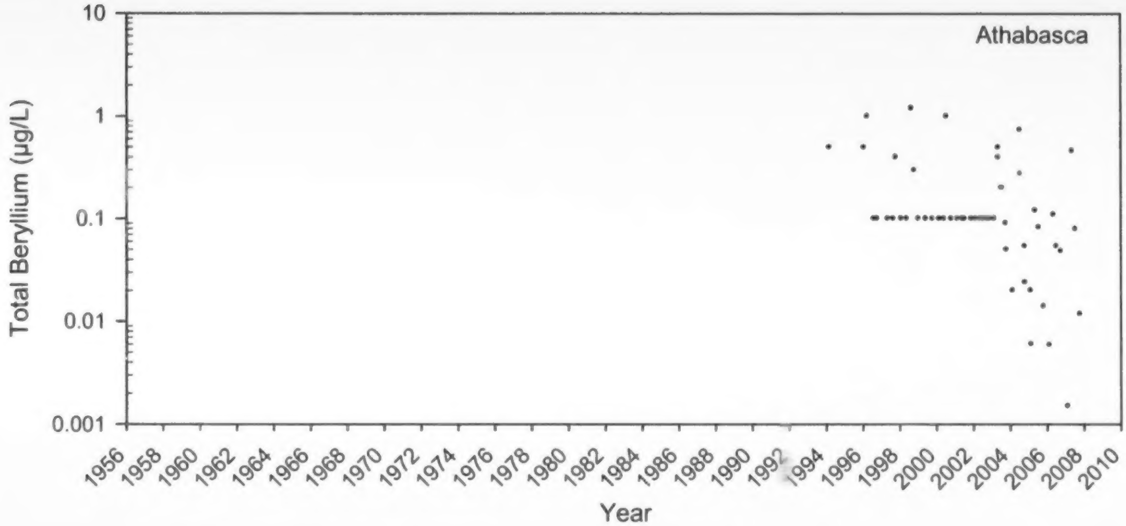


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0050		
Flow Adjusted								

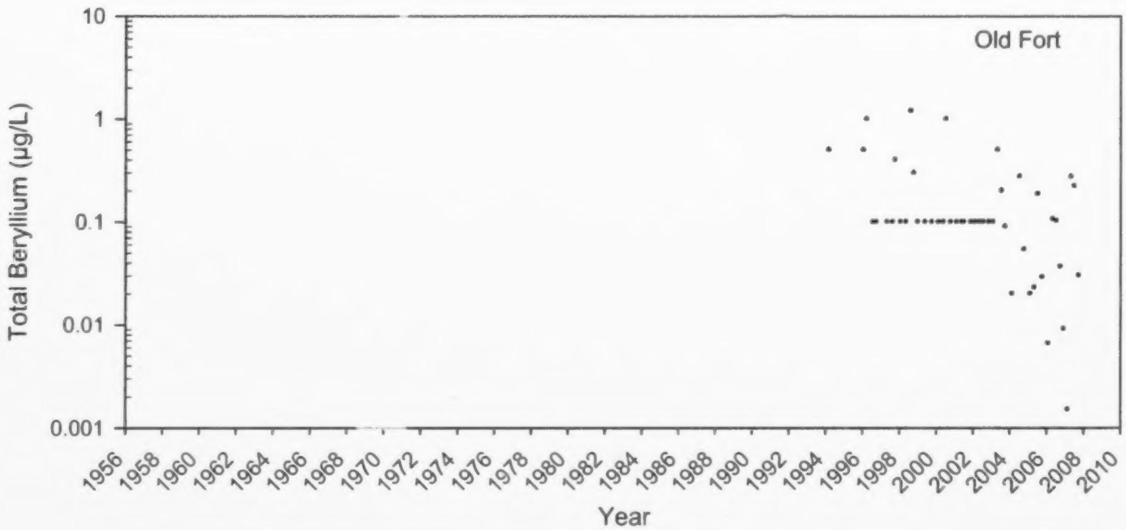


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0253		

Figure 160 Dissolved boron concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

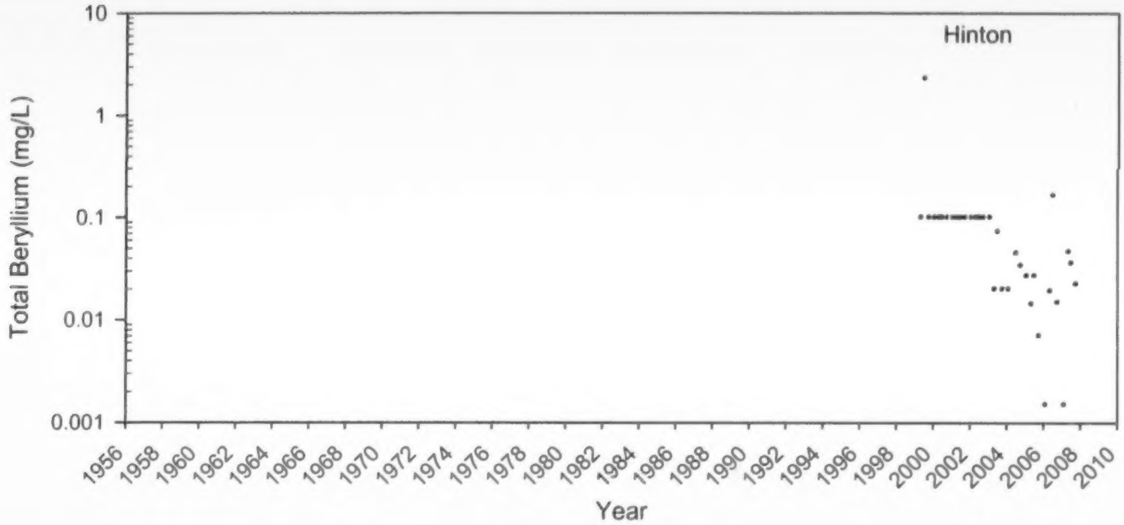


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0322		
Flow Adjusted								

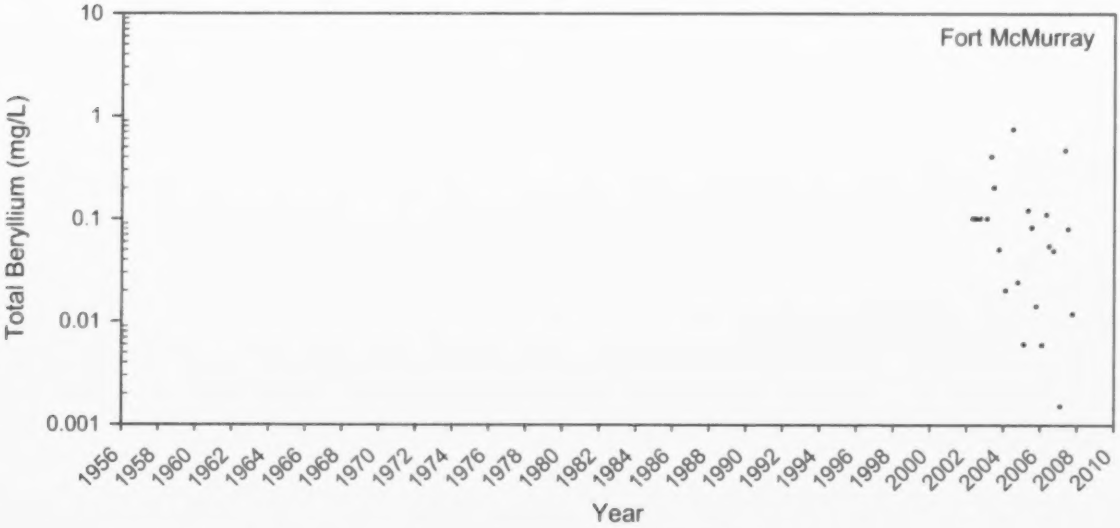


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0334		
Flow Adjusted								

Figure 161 Total beryllium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

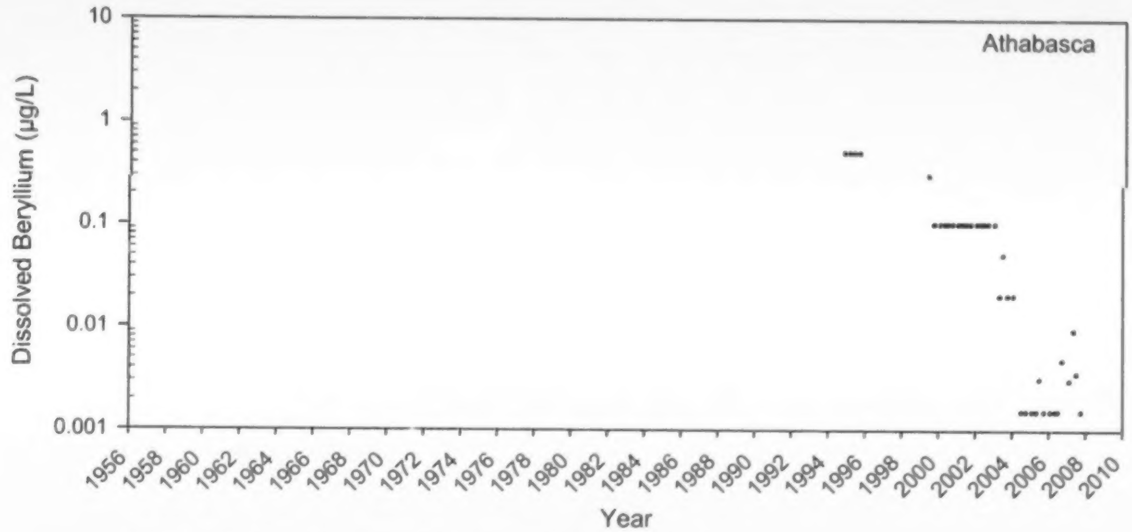


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0224		
Flow Adjusted								

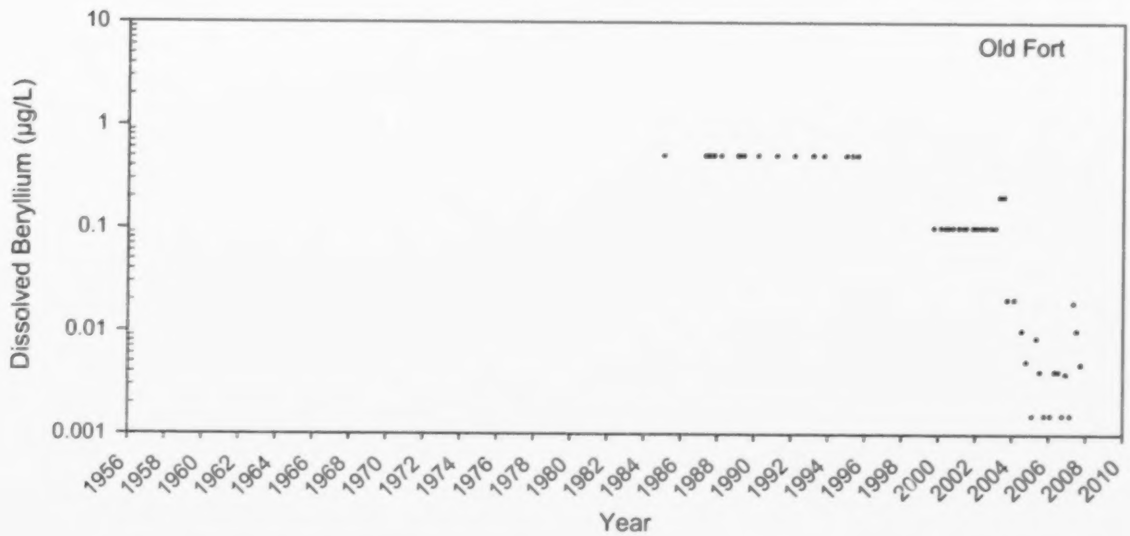


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0483		
Flow Adjusted								

Figure 162 Total beryllium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

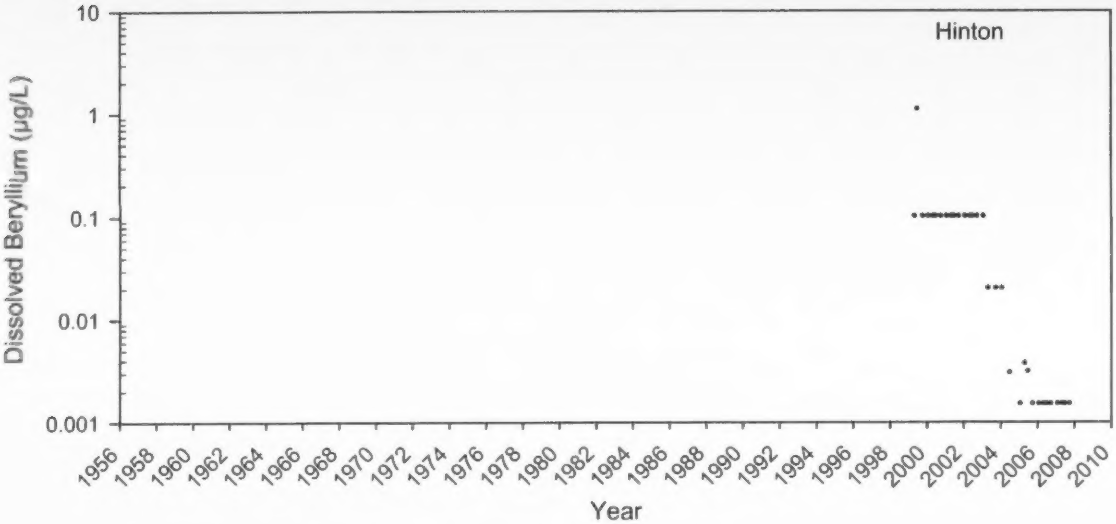


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0015		
Flow Adjusted								

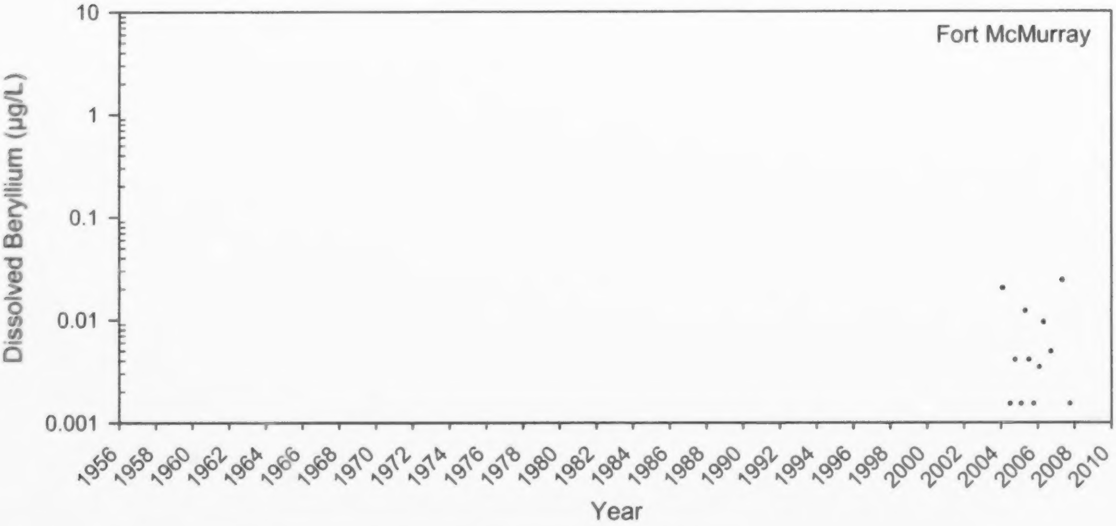


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0040		
Flow Adjusted								

Figure 163 Dissolved beryllium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

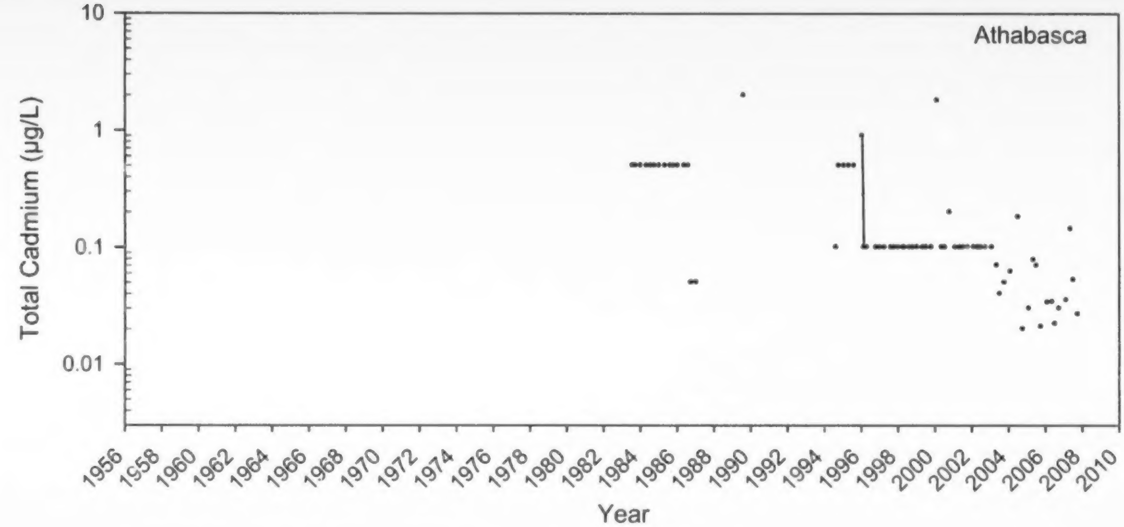


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0015		
Flow Adjusted								

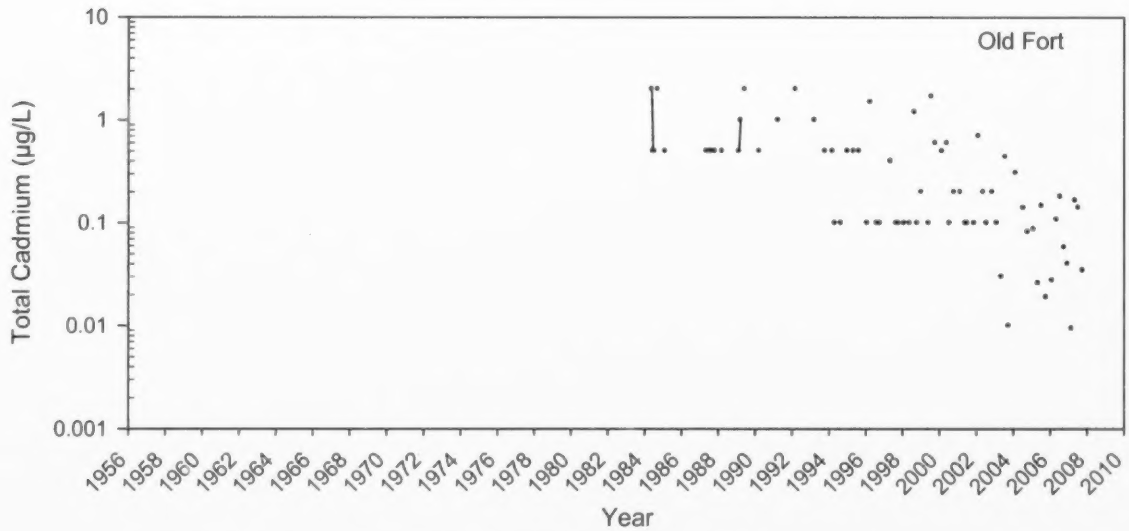


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0040		
Flow Adjusted								

Figure 164 Dissolved beryllium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

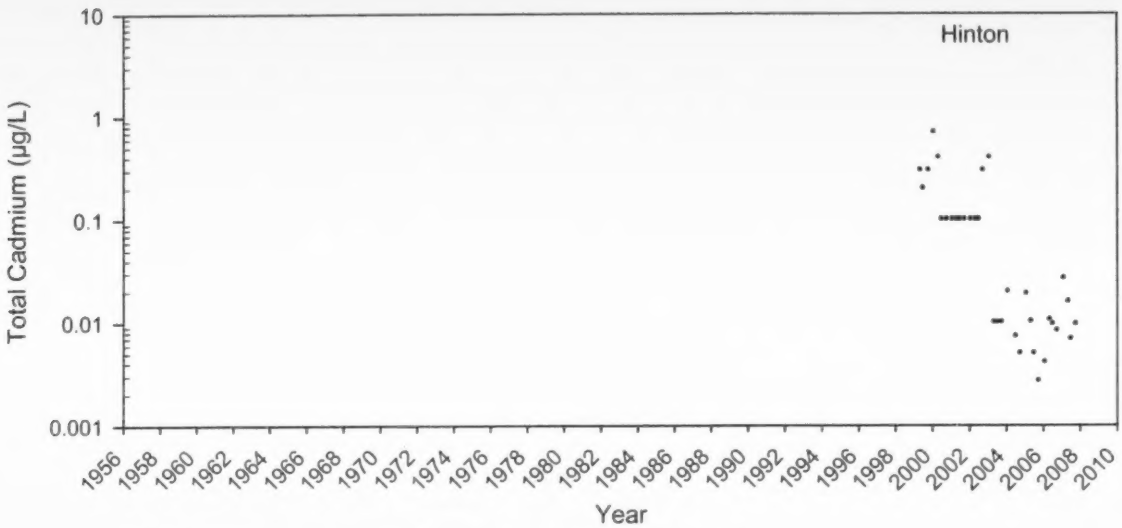


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0400		
Flow Adjusted								

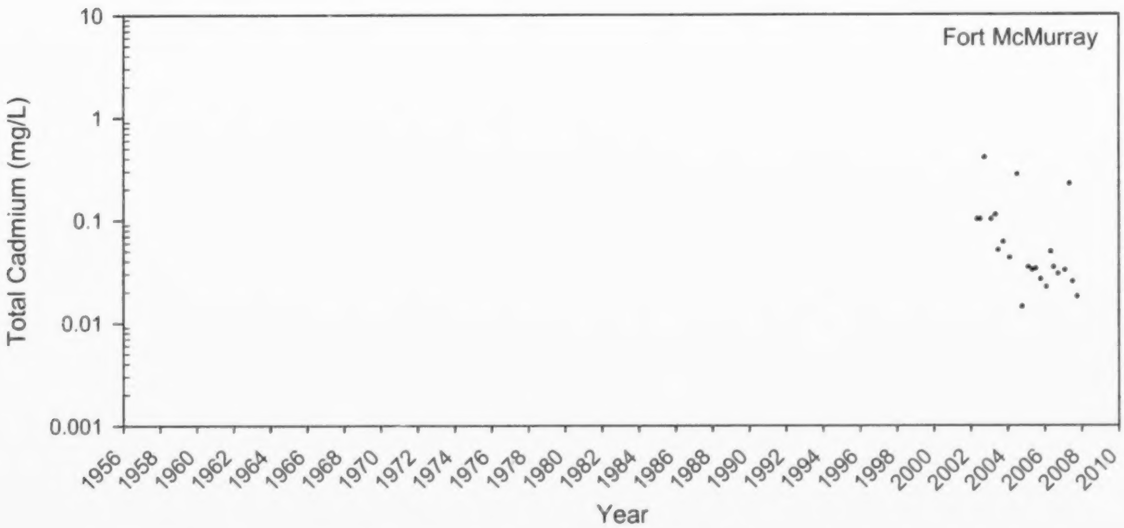


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0845		
Flow Adjusted								

Figure 165 Total cadmium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

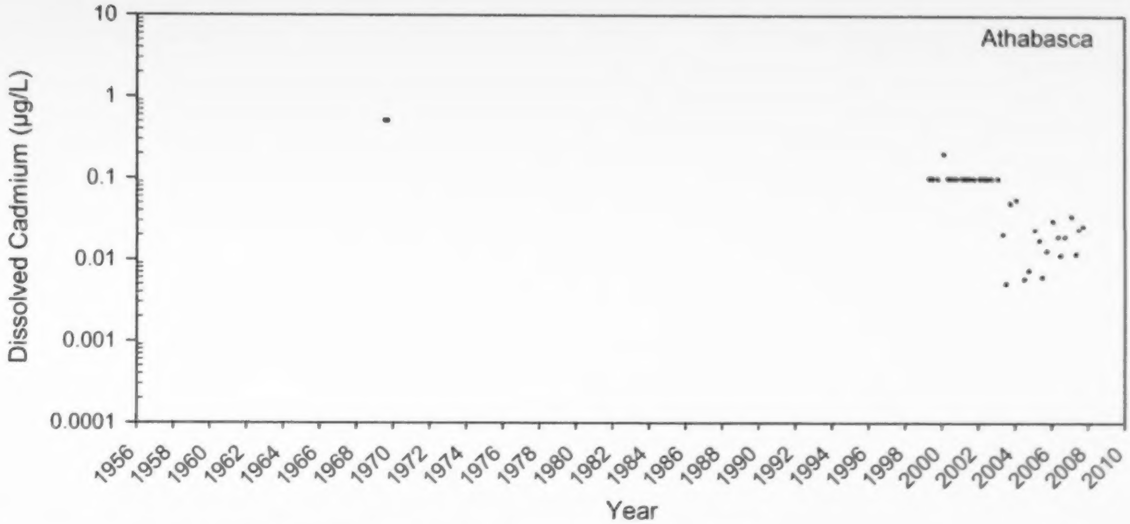


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0100		
Flow Adjusted								

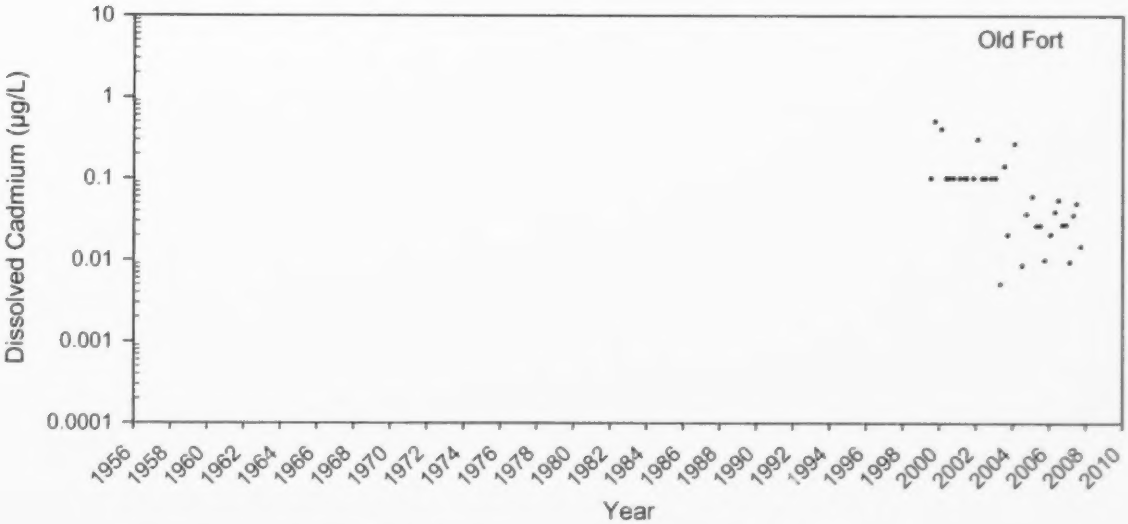


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0340		
Flow Adjusted								

Figure 166 Total cadmium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

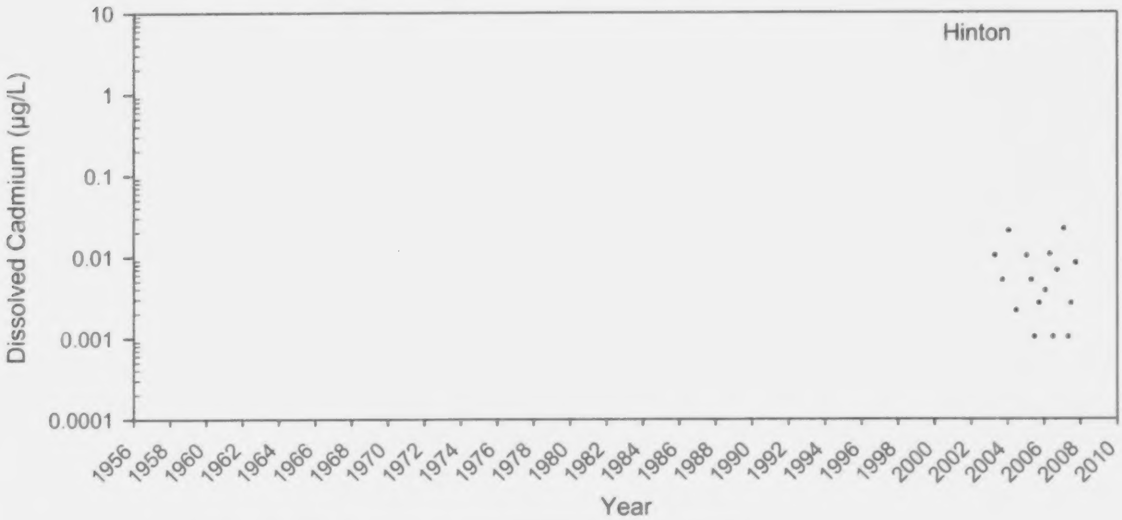


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0188		
Flow Adjusted								

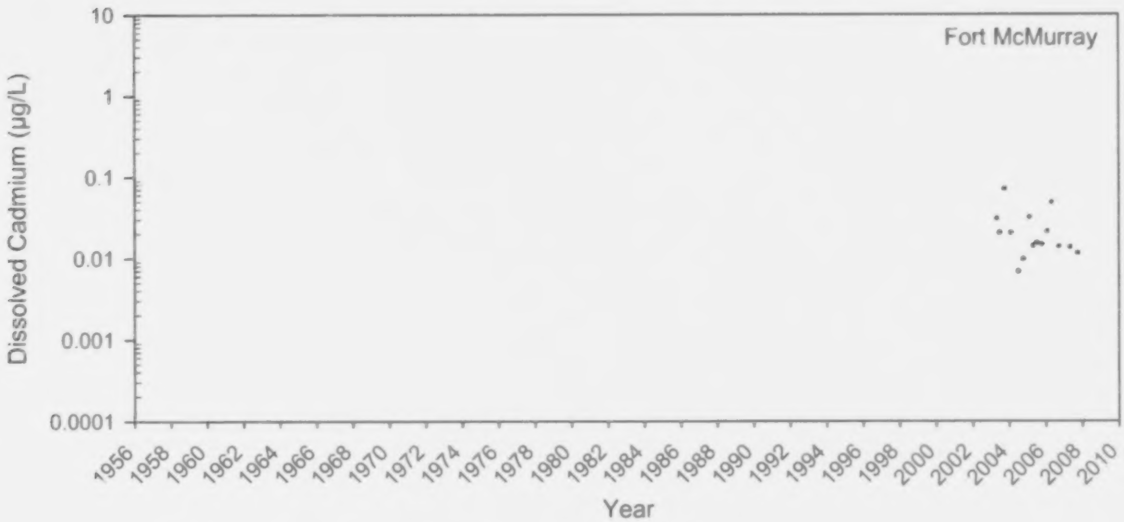


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0267		
Flow Adjusted								

Figure 167 Dissolved cadmium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

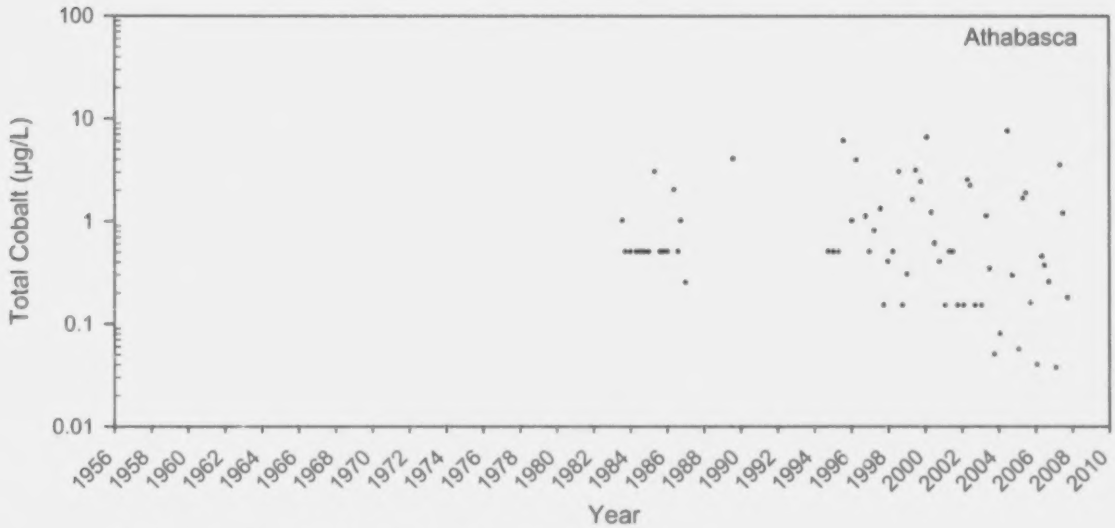


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig
						0.0050		
Flow Adjusted								

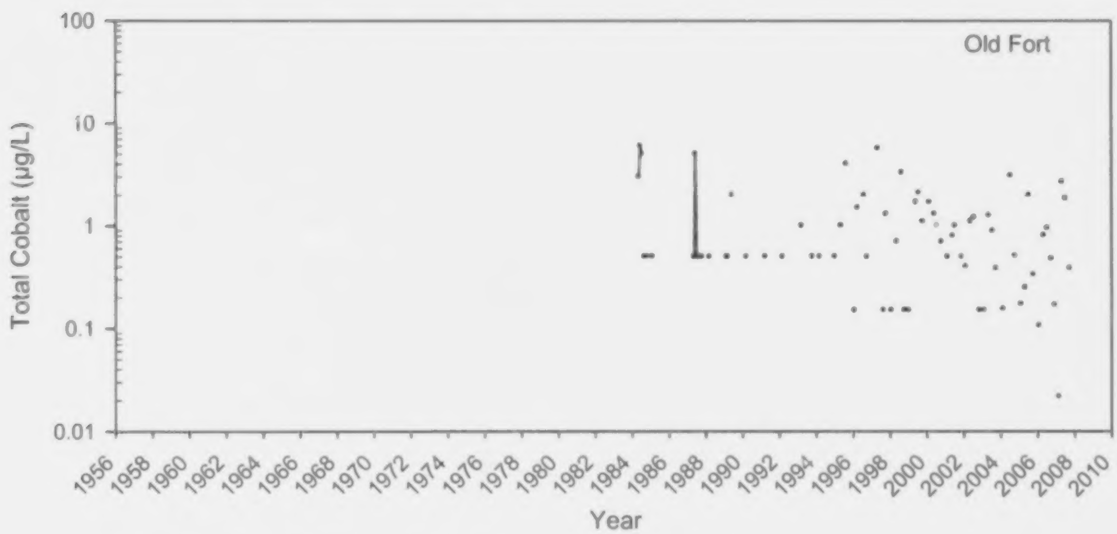


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0175		
Flow Adjusted								

Figure 168 Dissolved cadmium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

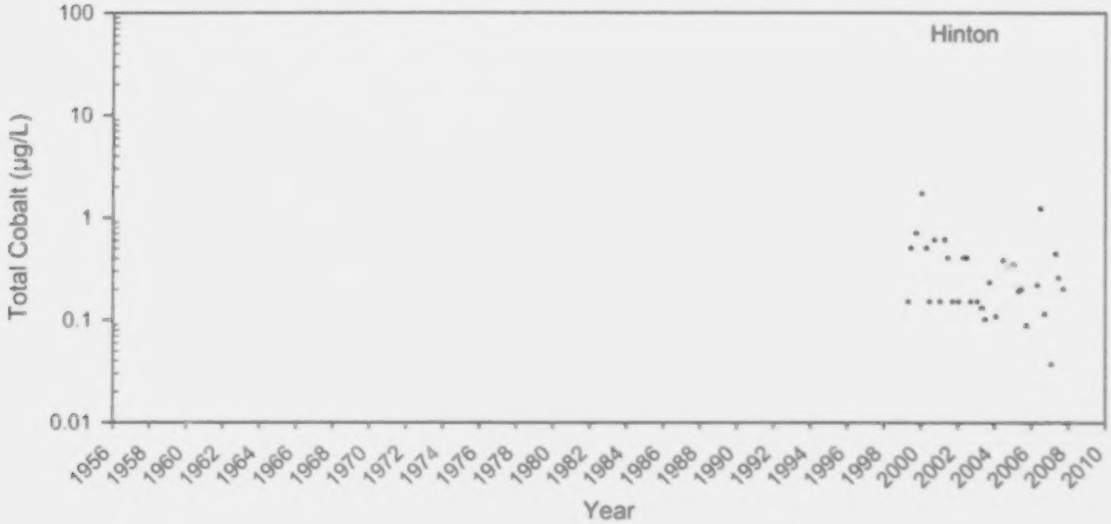


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.5000		
Flow Adjusted								

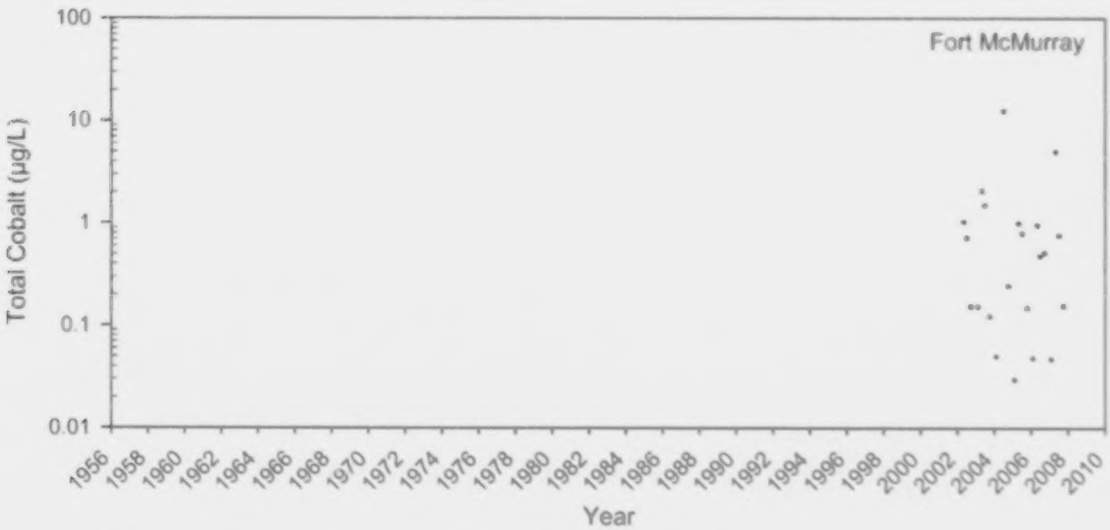


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.7000		
Flow Adjusted								

Figure 169 Total cobalt concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

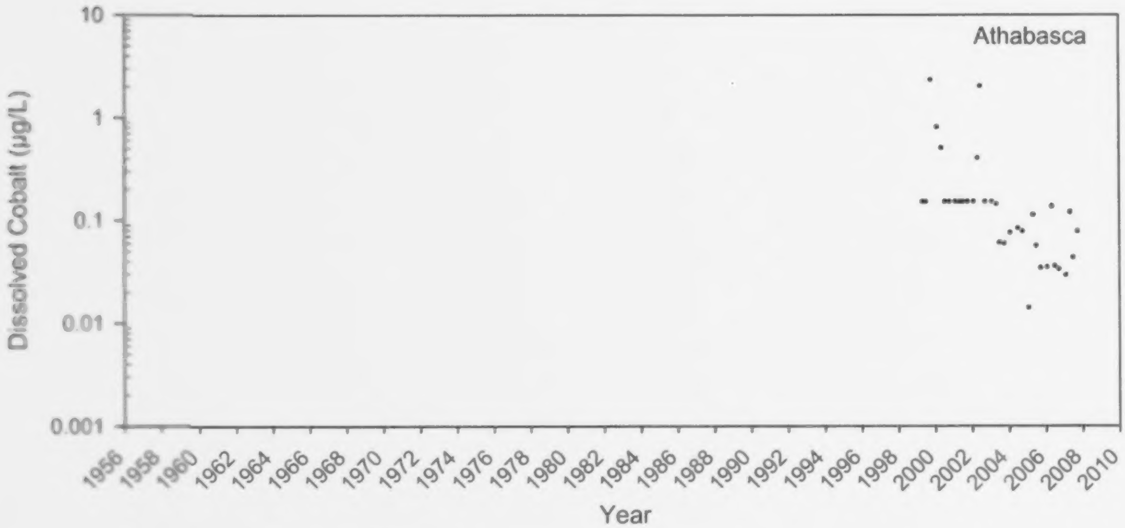


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.2170		
Flow Adjusted								

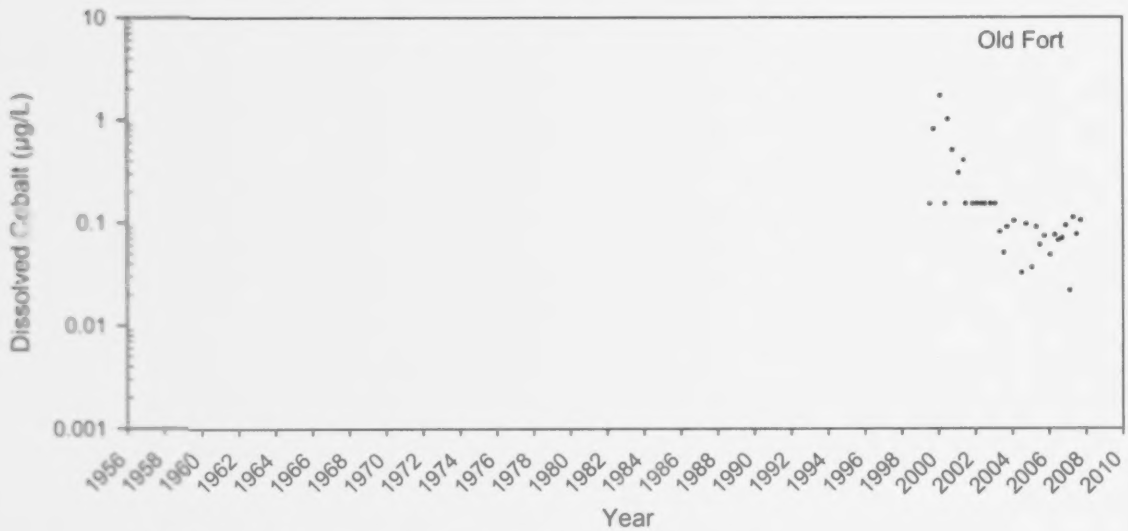


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.4825		
Flow Adjusted								

Figure 170 Total cobalt concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

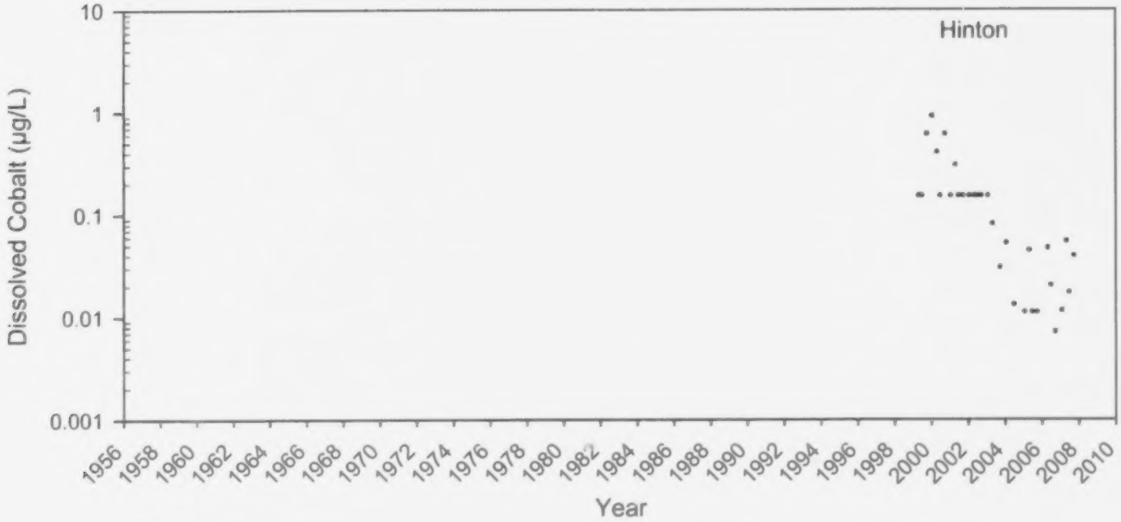


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0600		
Flow Adjusted								

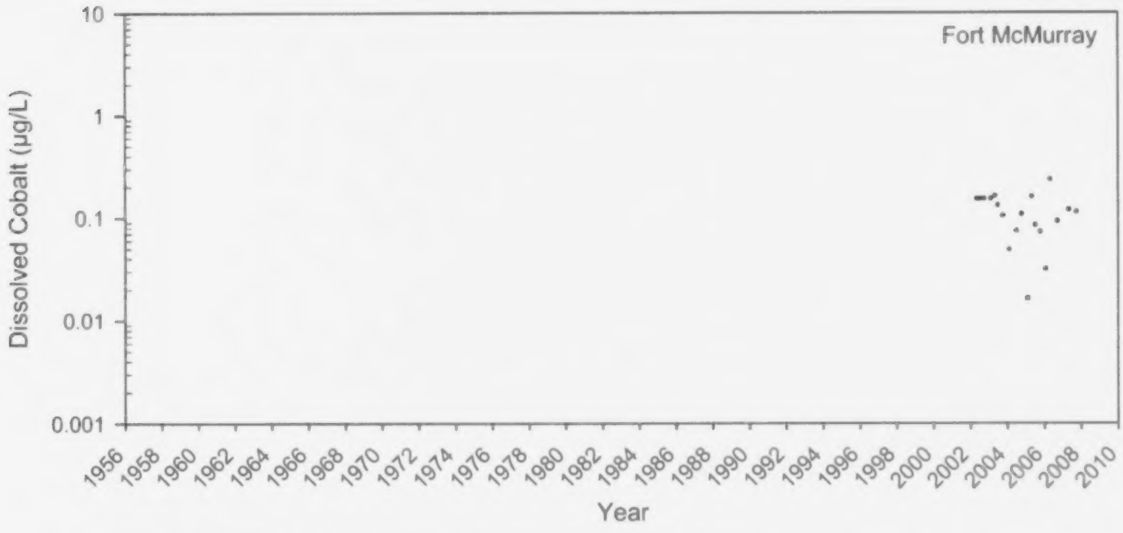


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0749		
Flow Adjusted								

Figure 171 Dissolved cobalt concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0202		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987			Post-1987		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.1045		

Figure 172 Dissolved cobalt concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

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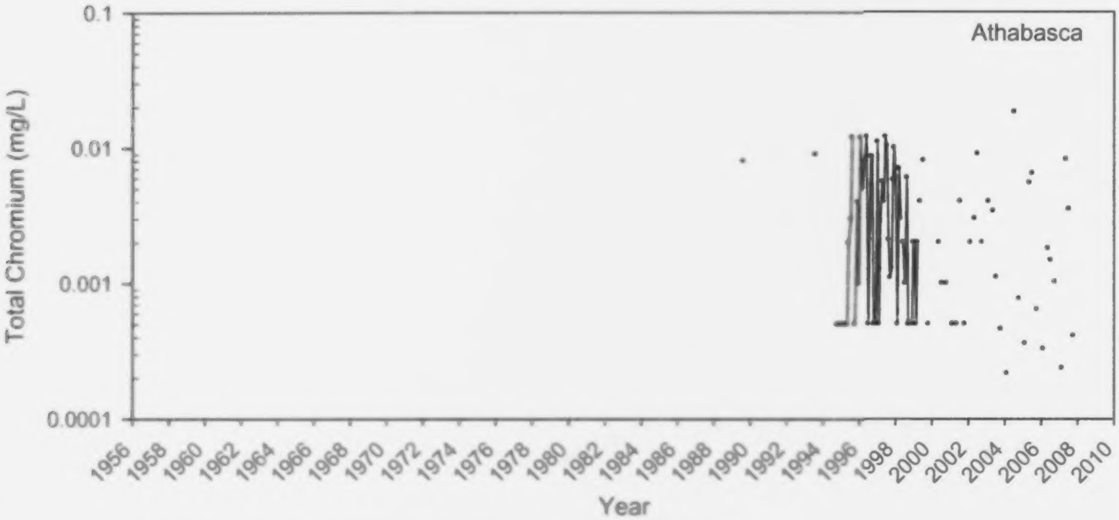
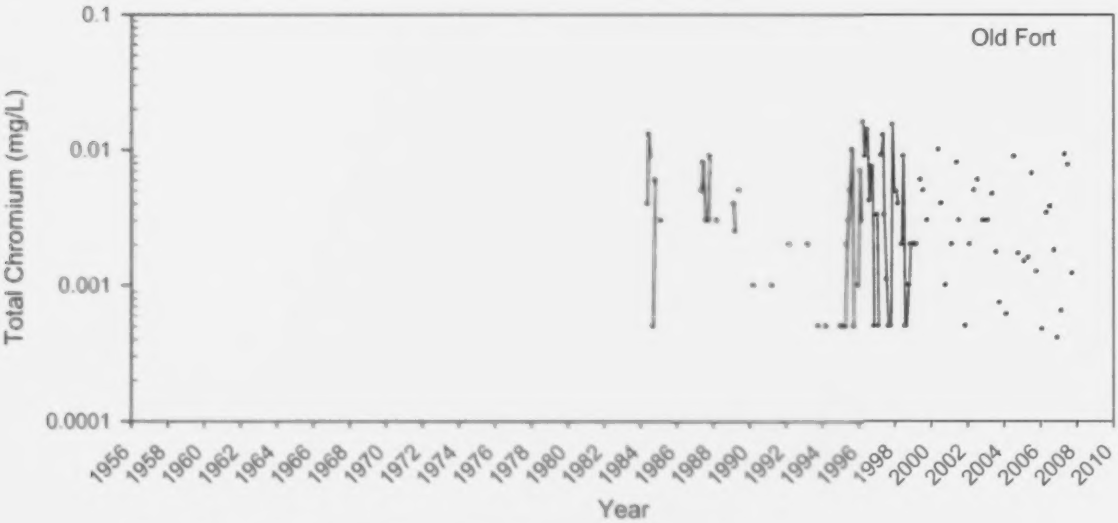
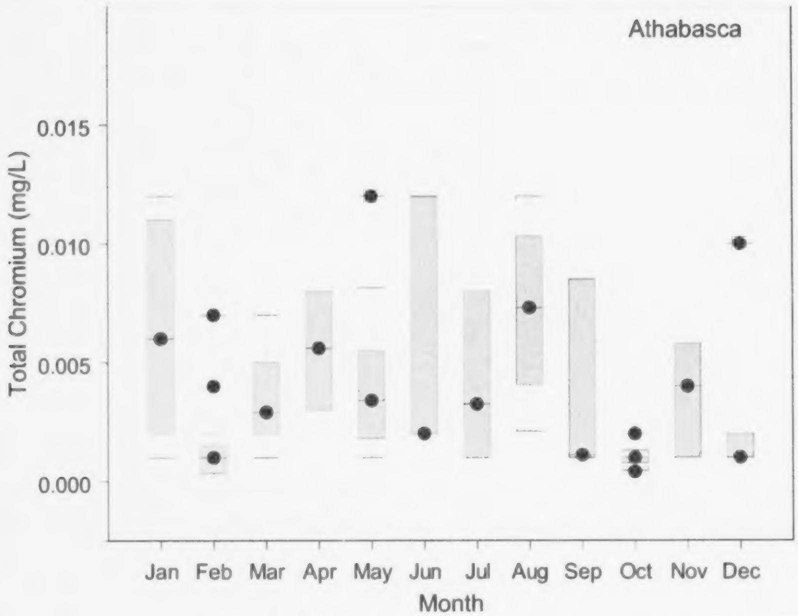


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0020		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987			Post-1987		
Slope	Sig.	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0020		

Figure 173 Total chromium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.



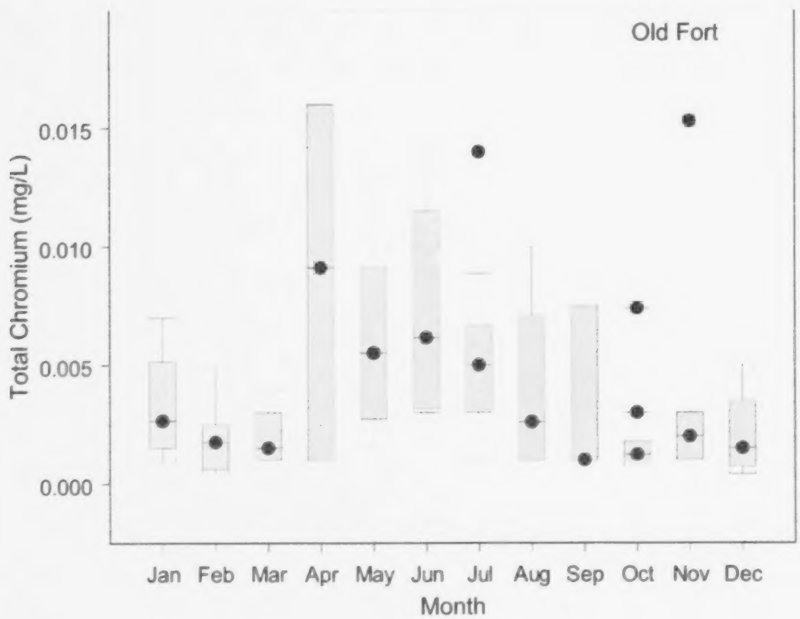
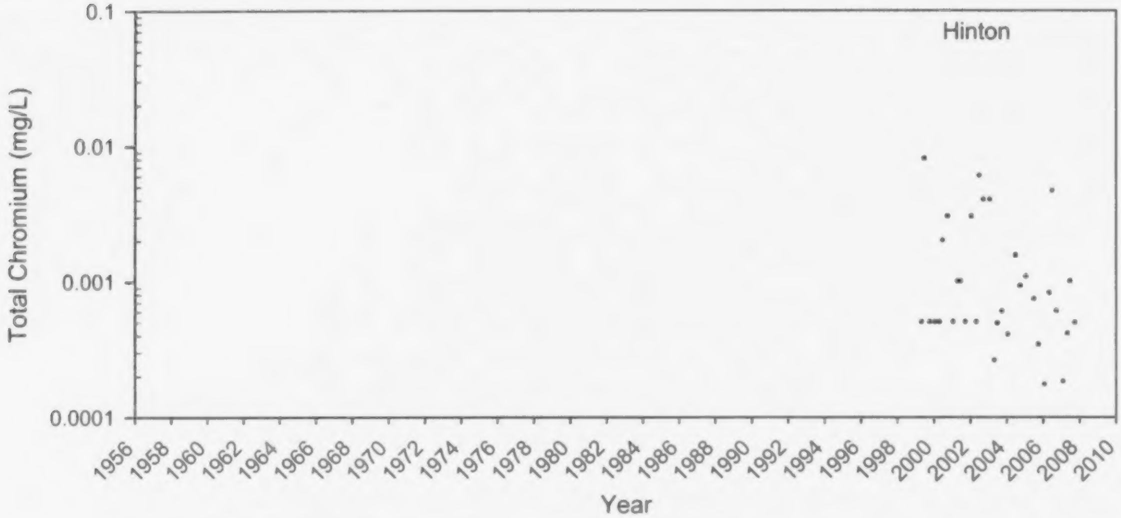
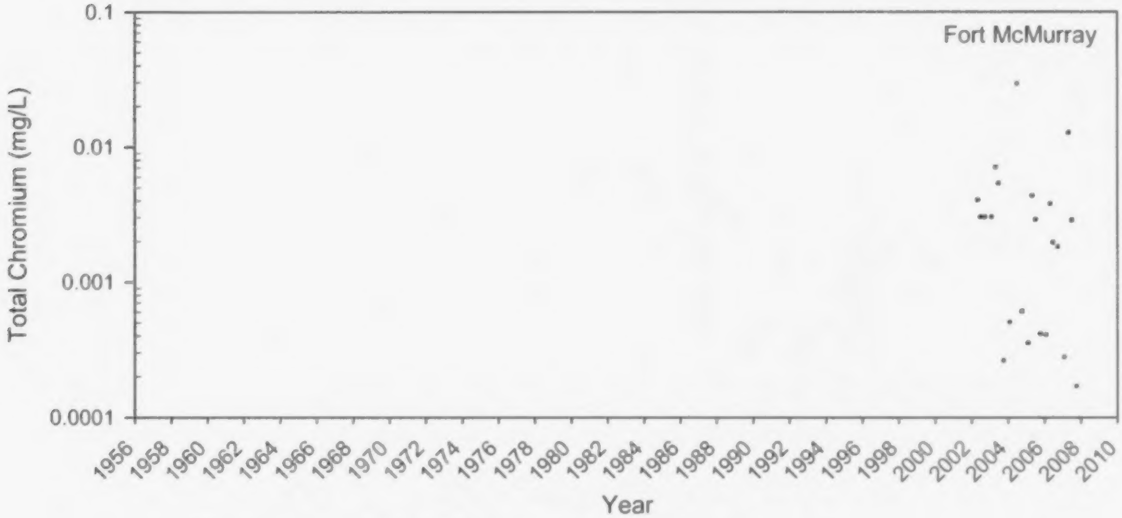


Figure 174 Seasonality of total chromium in the Athabasca River at Athabasca and Old Fort.

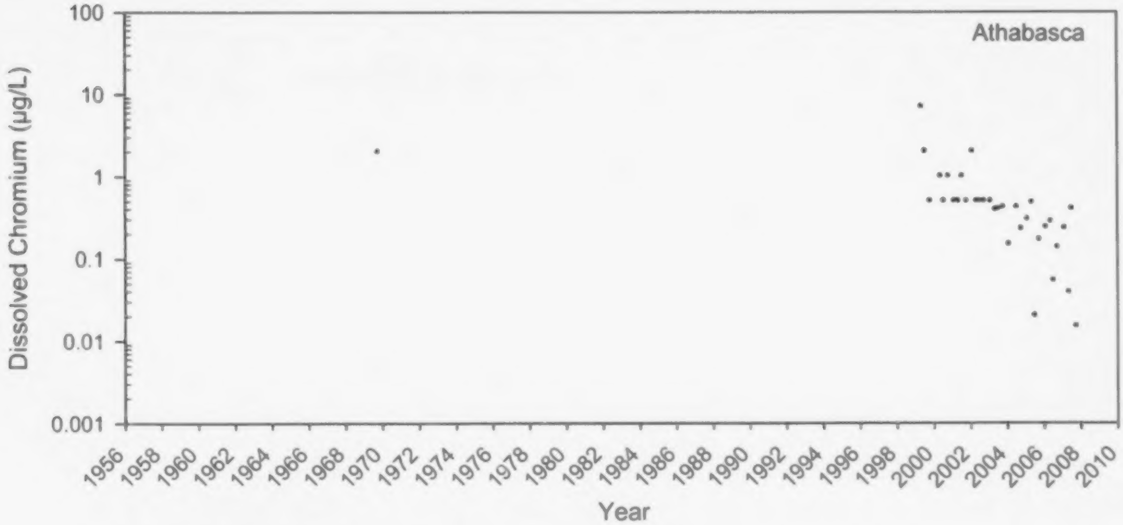


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0006		
Flow Adjusted								

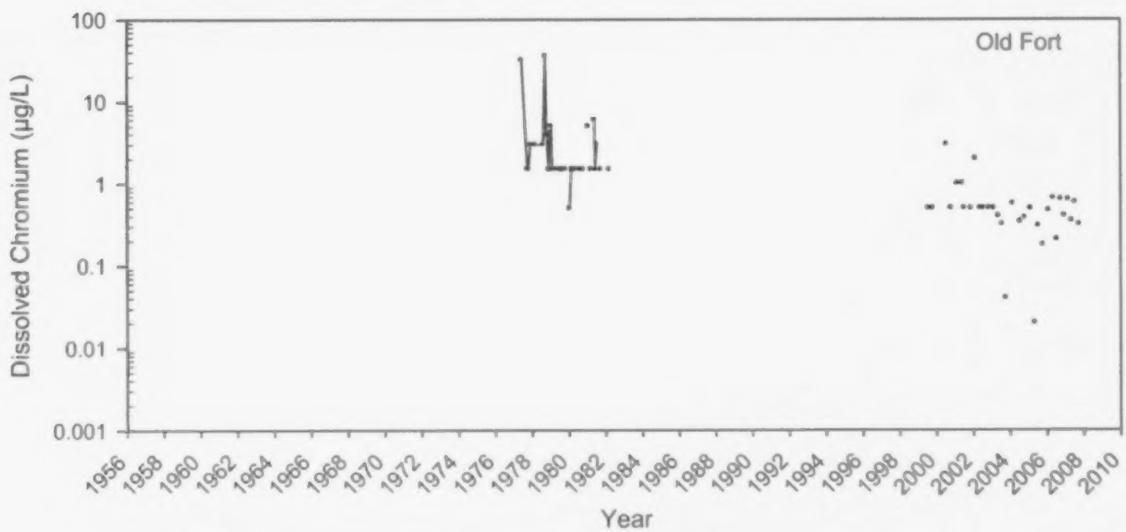


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0028		
Flow Adjusted								

Figure 175 Total chromium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

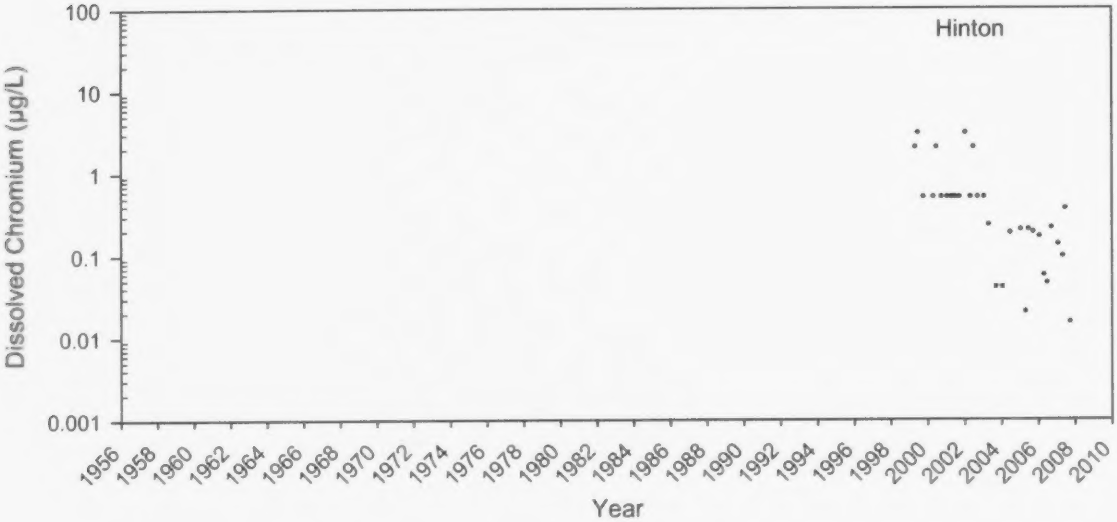


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.2400		
Flow Adjusted								

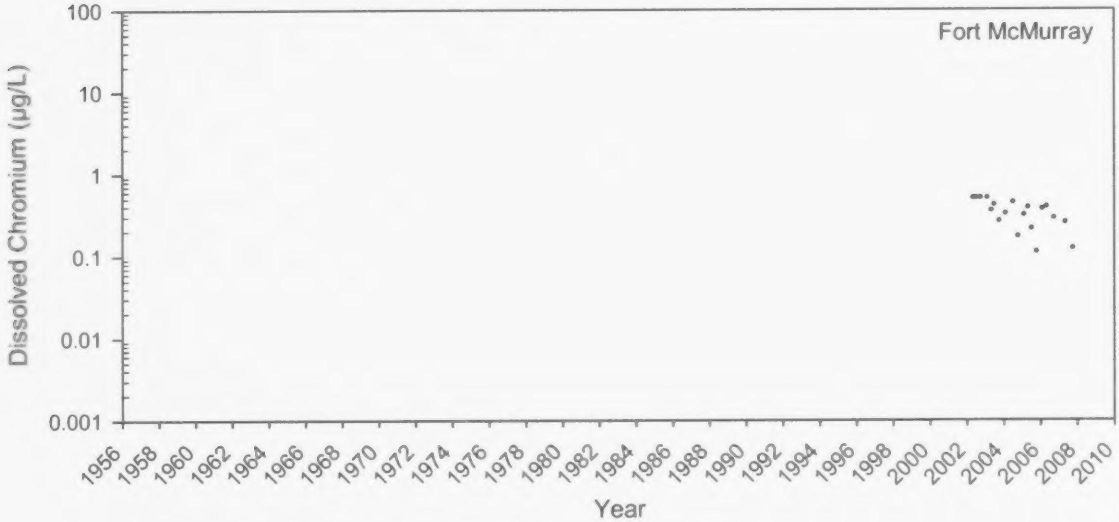


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.3900		
Flow Adjusted								

Figure 176 Dissolved chromium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

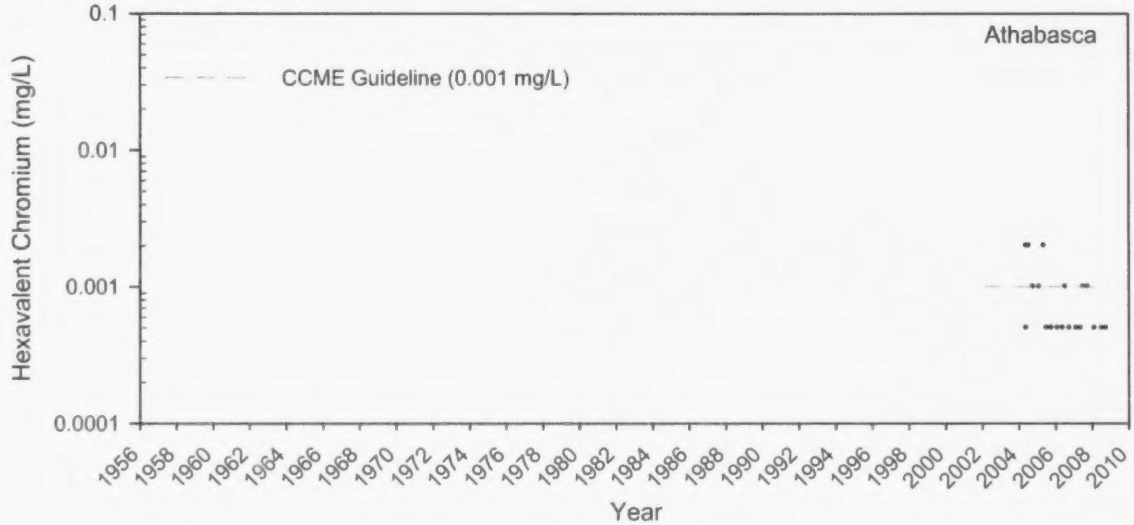


Overall Trend		1987 Step Trend	Pre-1987			Post-1987		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.1650		
Flow Adjusted								

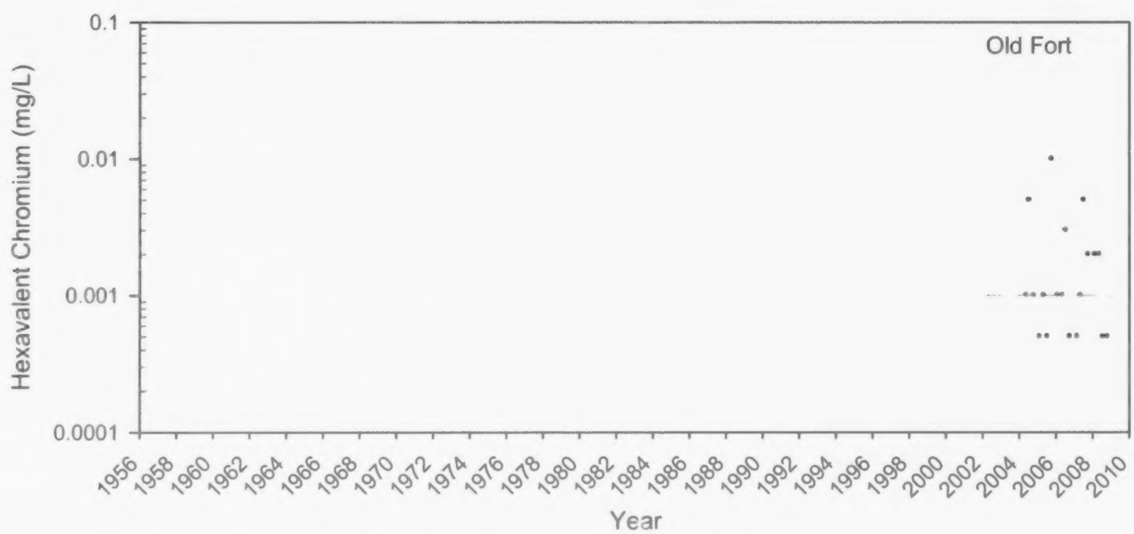


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.3150		
Flow Adjusted								

Figure 177 Dissolved chromium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

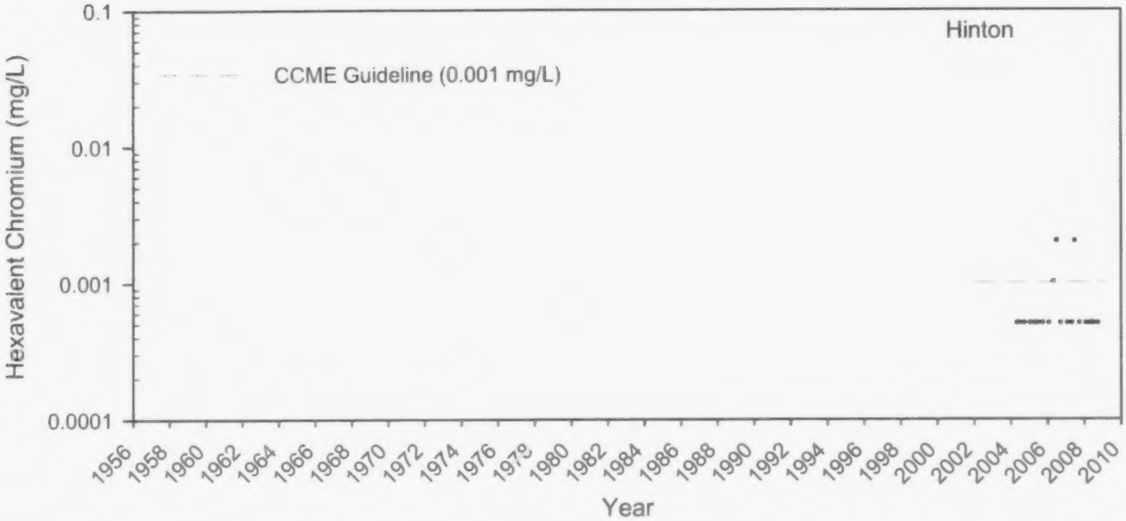


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0005		
Flow Adjusted								

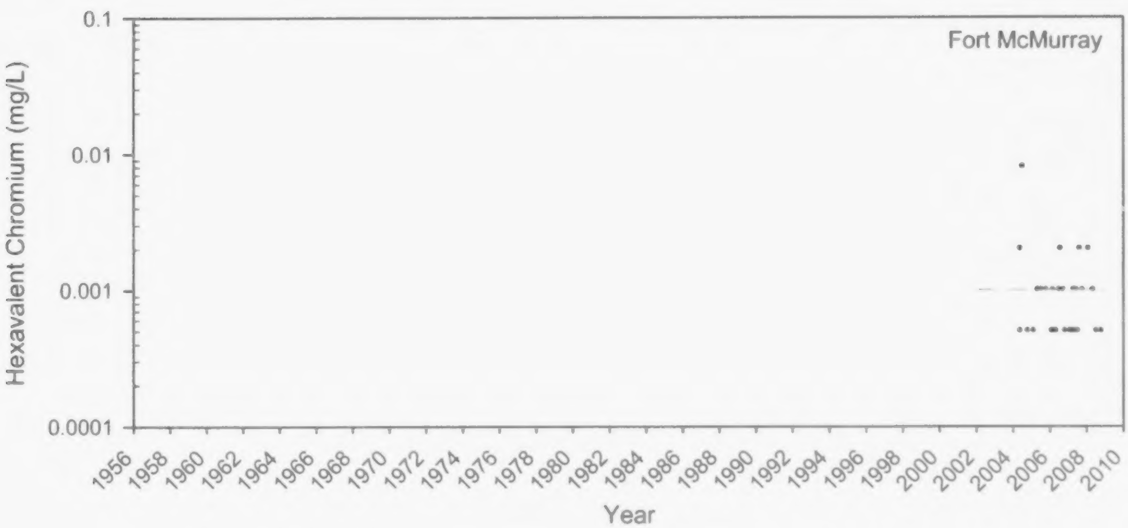


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0010		
Flow Adjusted								

Figure 178 Hexavalent chromium in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend assessment at this time.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0005		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.0010		
Flow Adjusted								

Figure 179 Hexavalent Chromium in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend assessment at this time.

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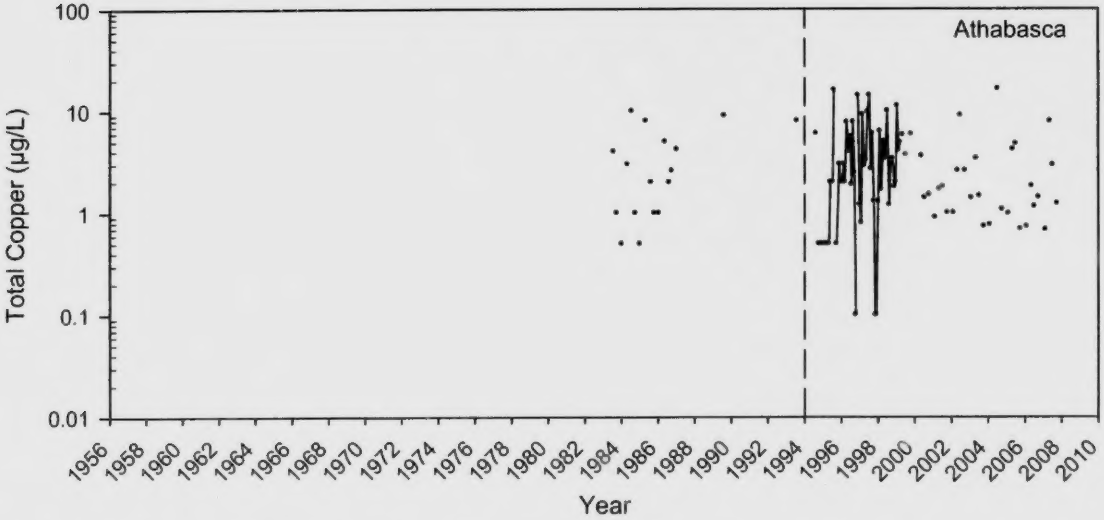
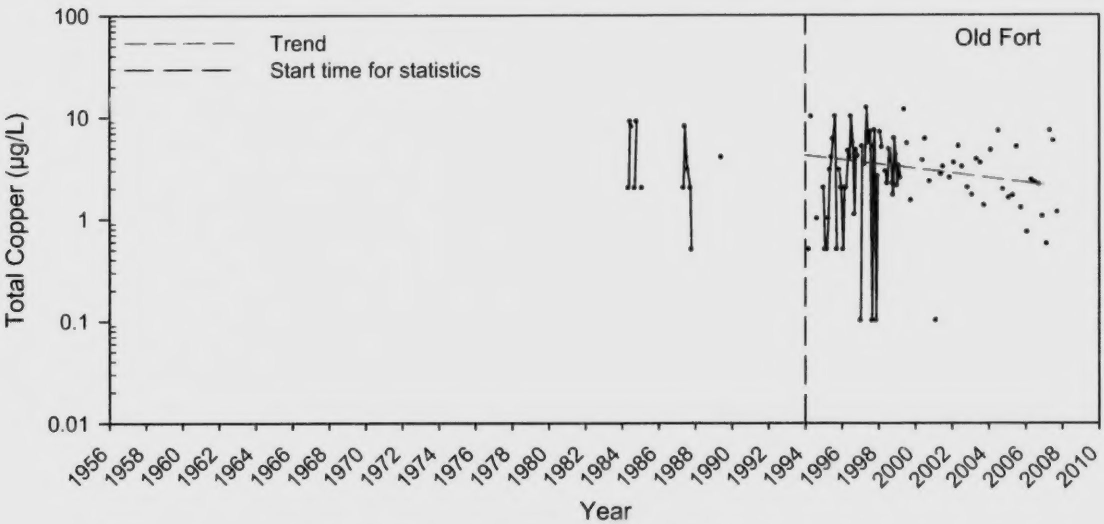


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						2.0000	-0.0571	none
Flow Adjusted								
							-0.1095	none



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						2.9500	-0.1592	down
Flow Adjusted								
							-0.1856	none

Figure 180 Total copper concentration in the Athabasca River at Athabasca and Old Fort. Significance of monotonic trends was determined at a 95% confidence interval (i.e., p<005). Hashed vertical line represents begin of analysed data.

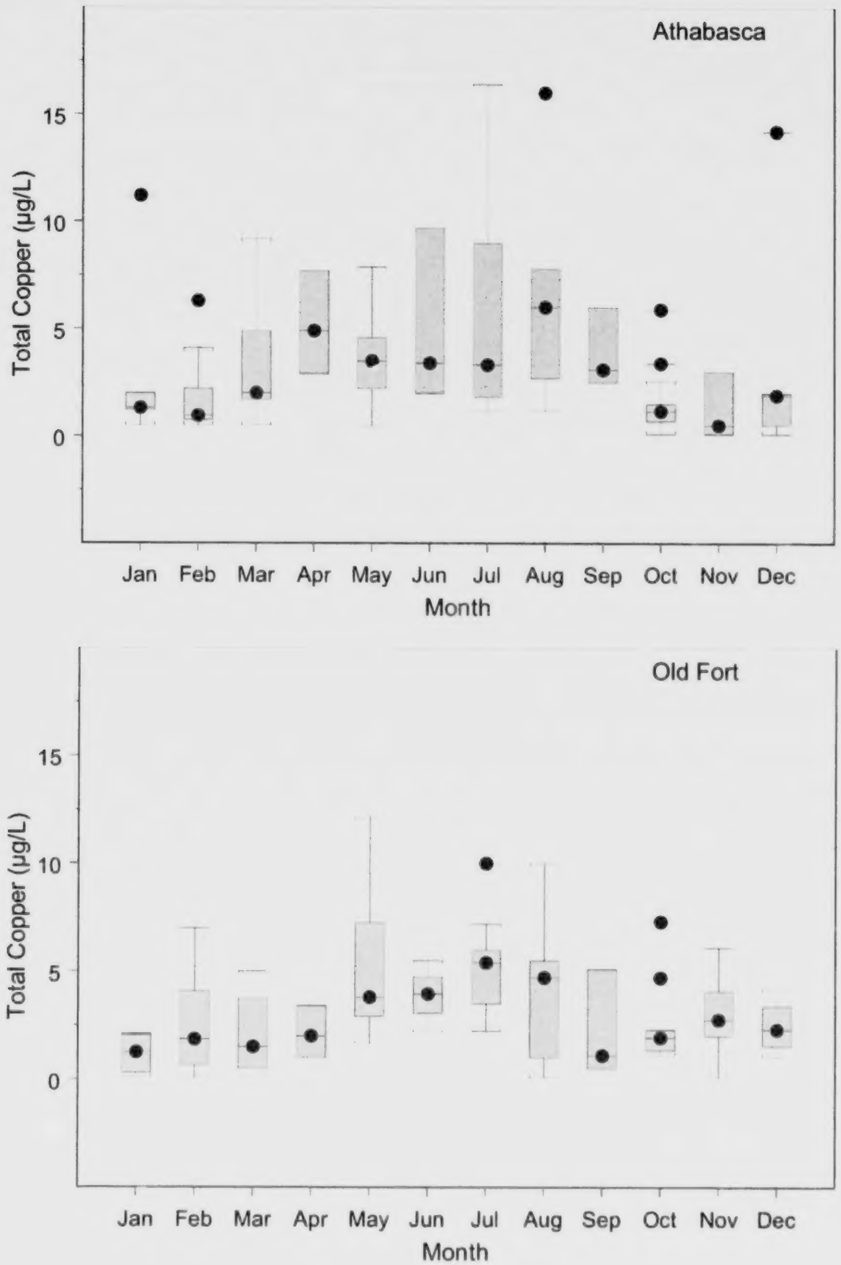
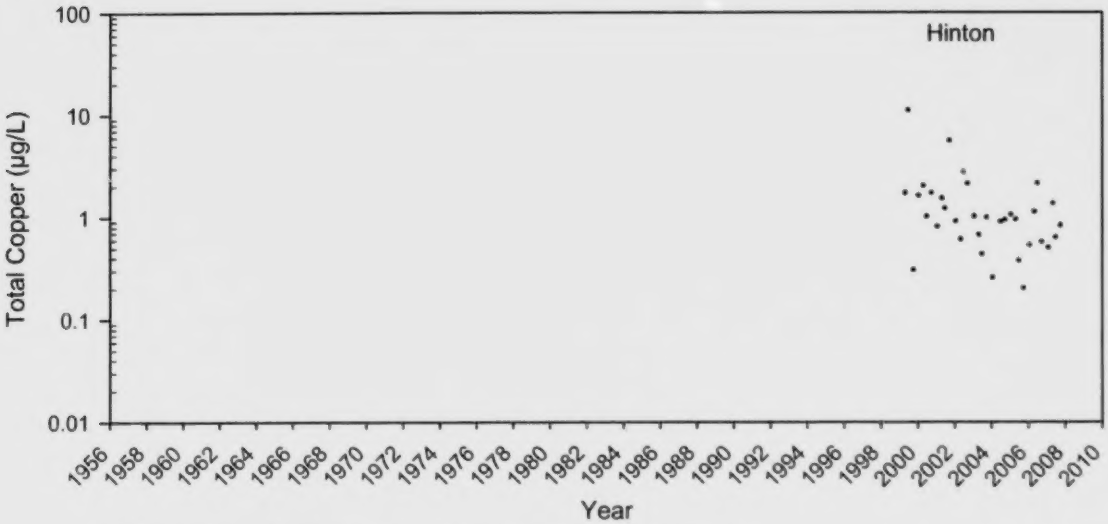
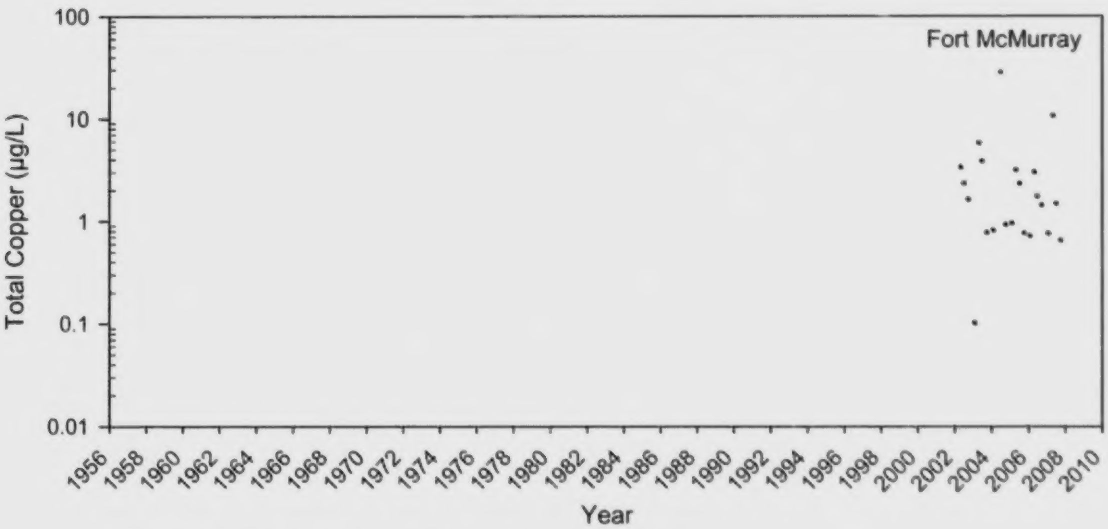


Figure 181 Seasonality of total copper in the Athabasca River at Athabasca and Old Fort.

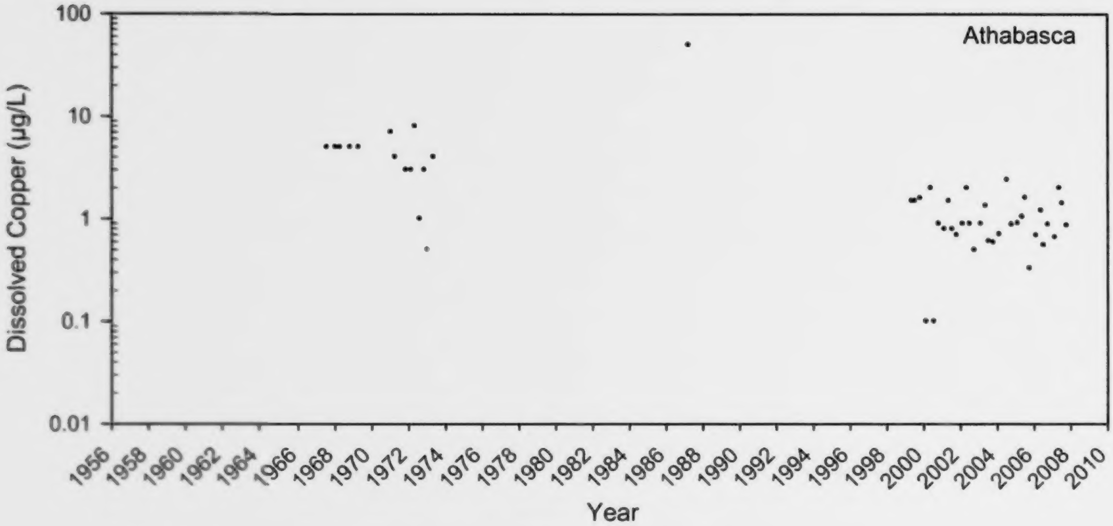


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.9400		
Flow Adjusted								

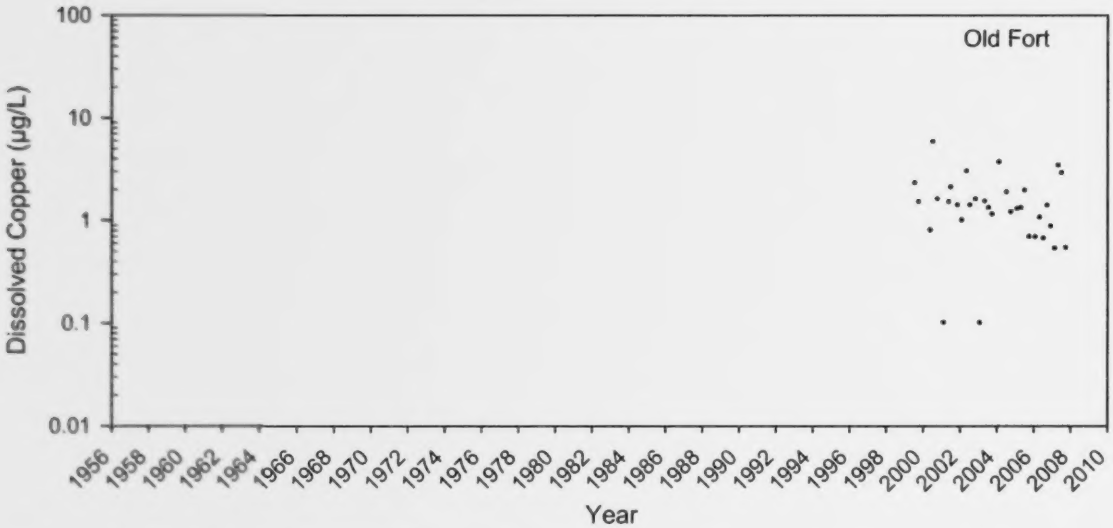


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						1.5300		

Figure 182 Total copper concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

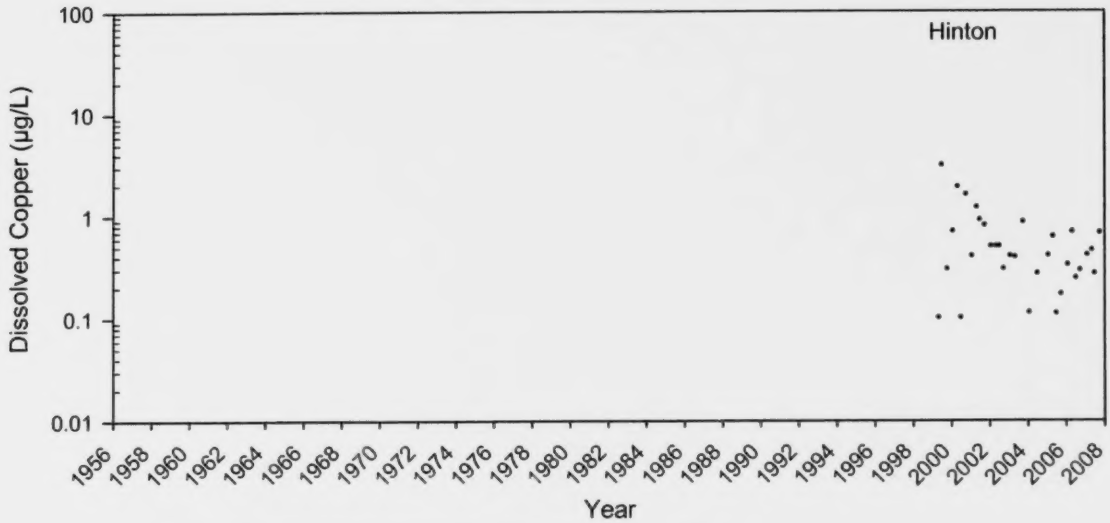


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.9000		
Flow Adjusted								

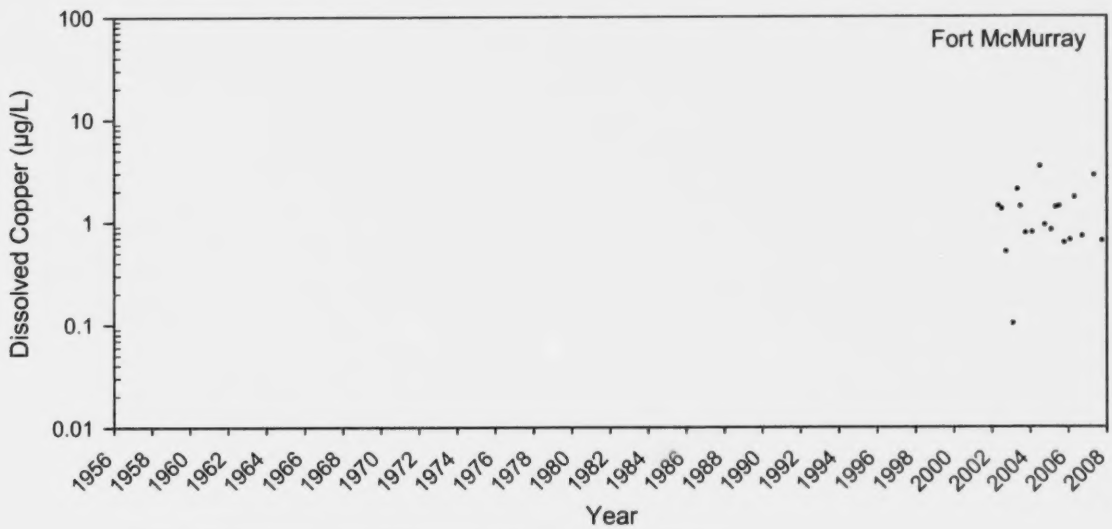


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						1.3900		
Flow Adjusted								

Figure 183 Dissolved copper concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.4090		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.9100		
Flow Adjusted								

Figure 184 Dissolved copper concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

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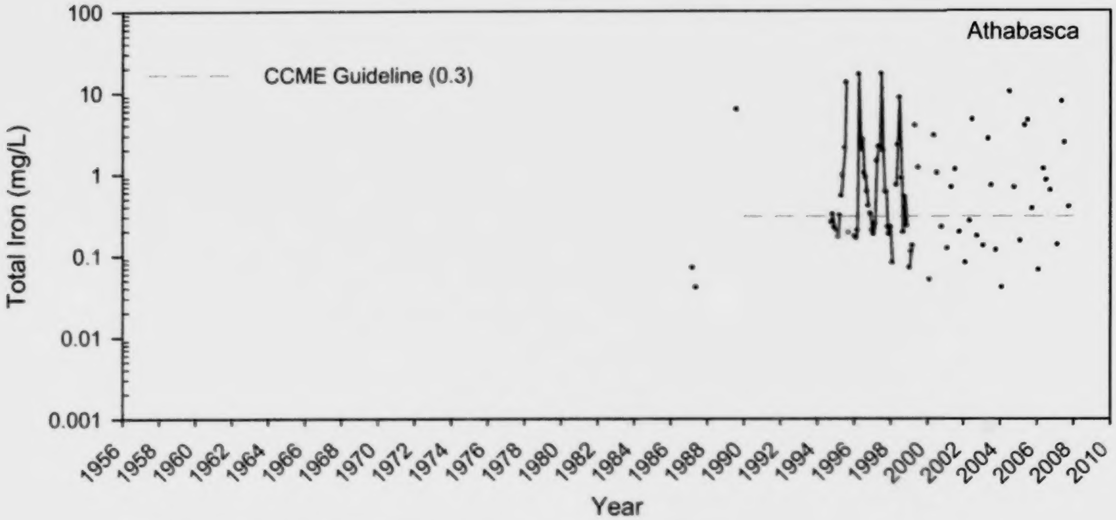
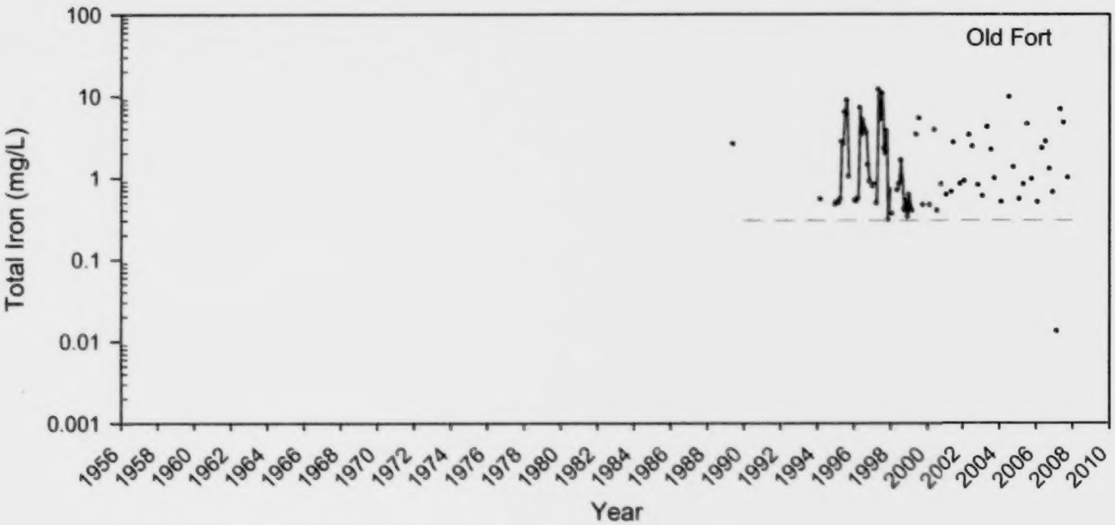


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.4550	0.0050	none
Flow Adjusted								
							-0.0155	none



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.8900	0.0167	none
Flow Adjusted								
							0.0089	none

Figure 185 Total iron concentration in the Athabasca River at Athabasca and Old Fort. Significance of monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$).

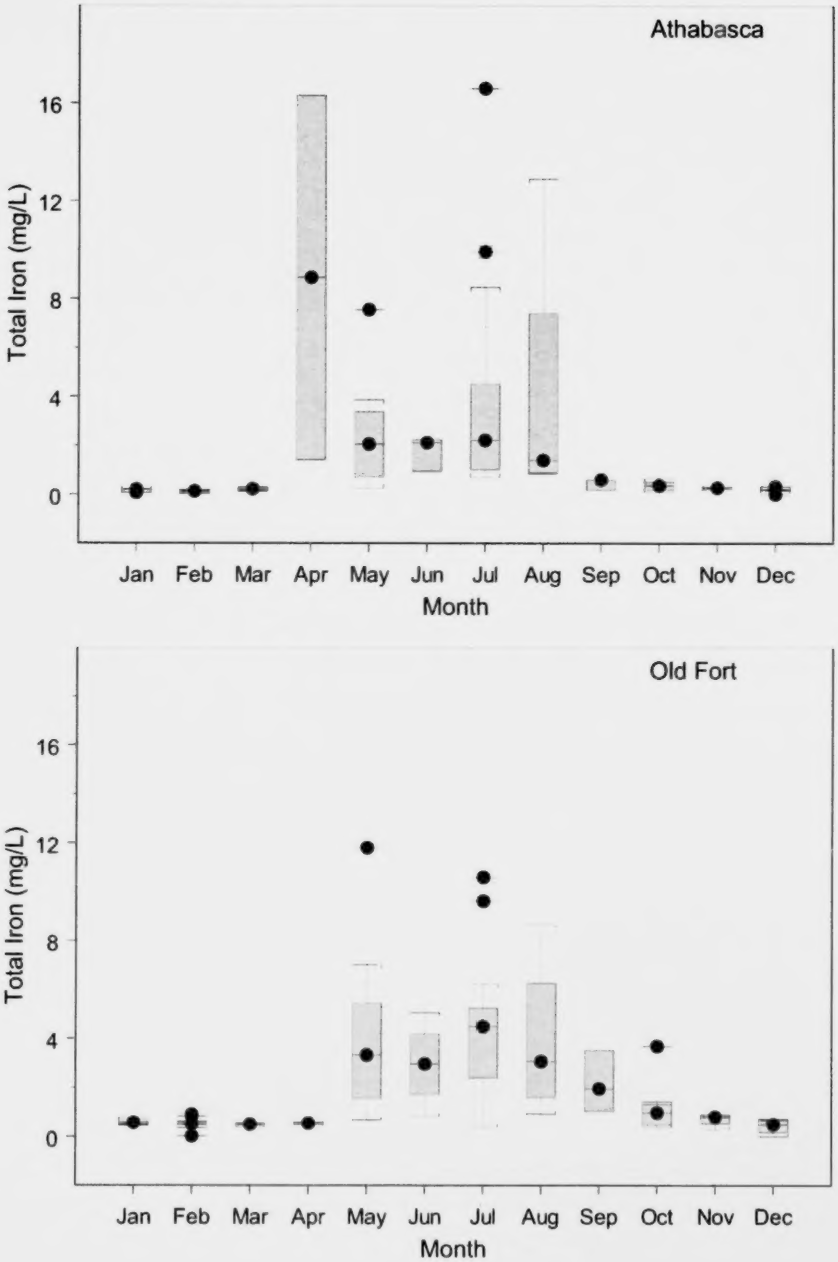
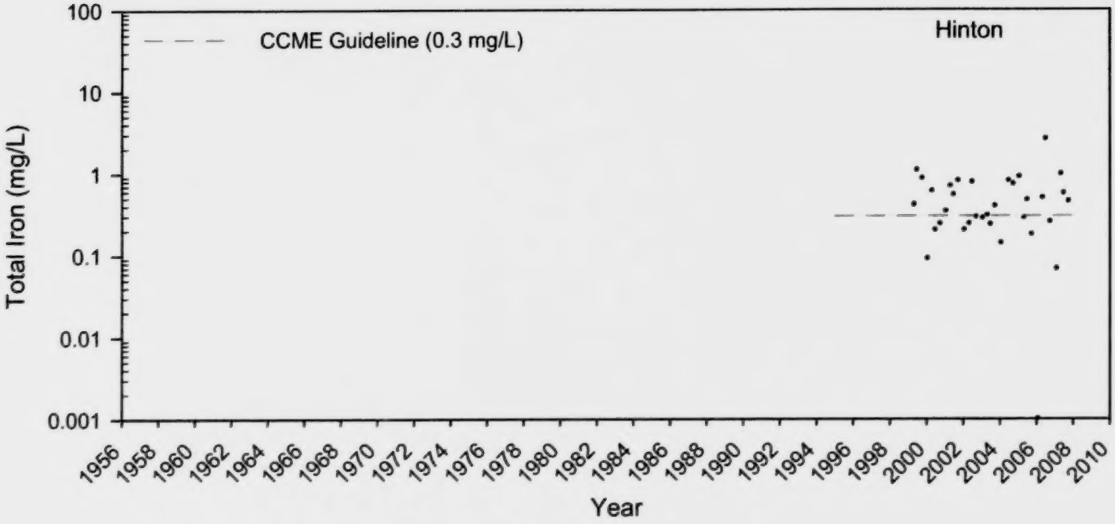
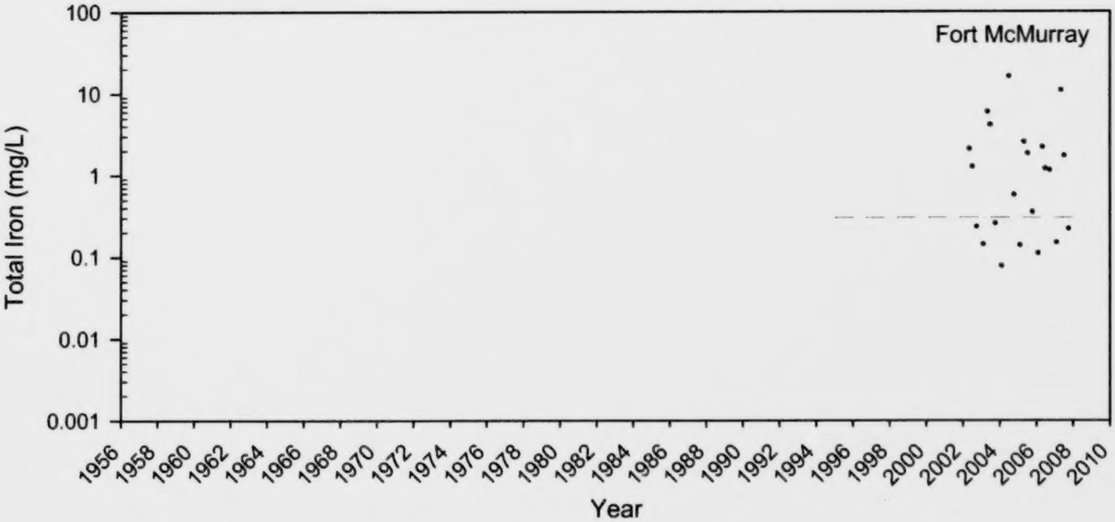


Figure 186 Seasonality of total iron concentration in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.3930		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						1.1550		
Flow Adjusted								

Figure 187 Total iron concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time

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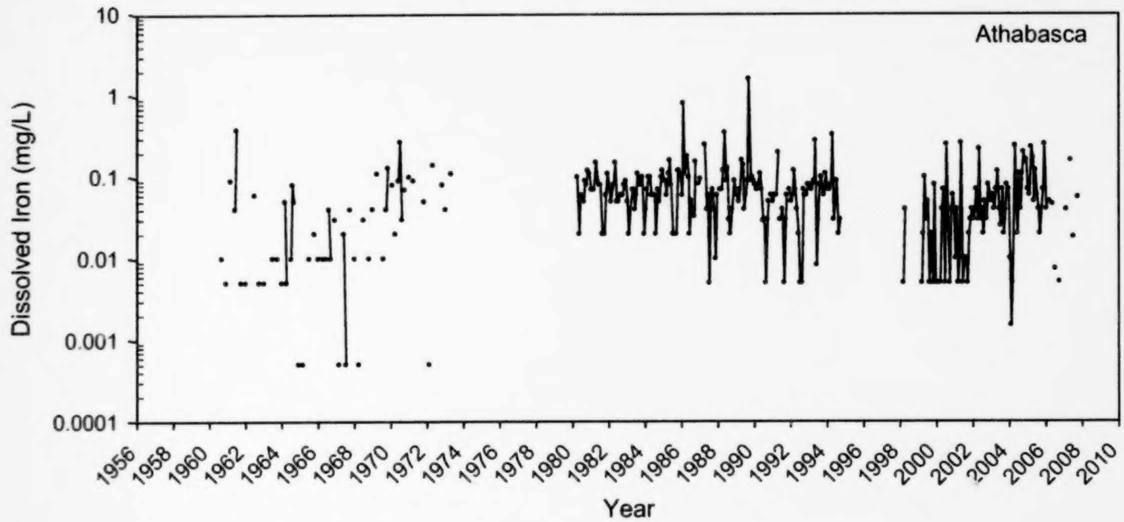
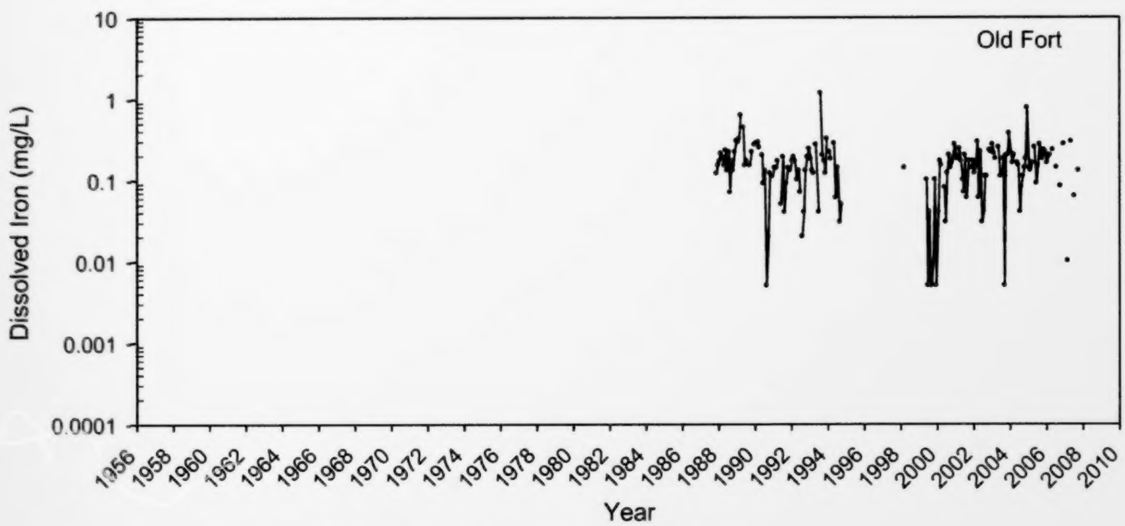
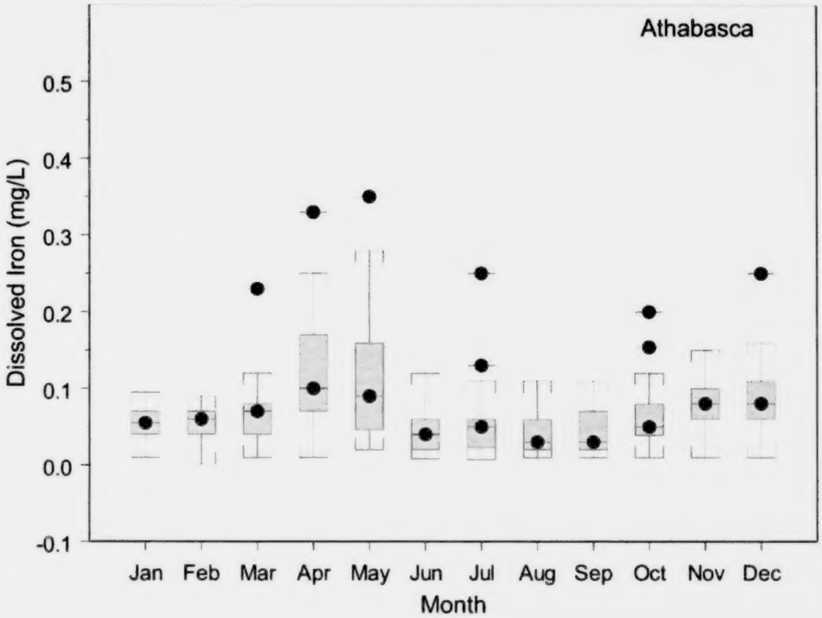


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0600	ID	ID
Flow Adjusted								
							ID	ID



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.1600	ID	ID
Flow Adjusted								
							ID	ID

Figure 188 Dissolved iron concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time. Data gaps and censorship preclude trend assessment on these data.



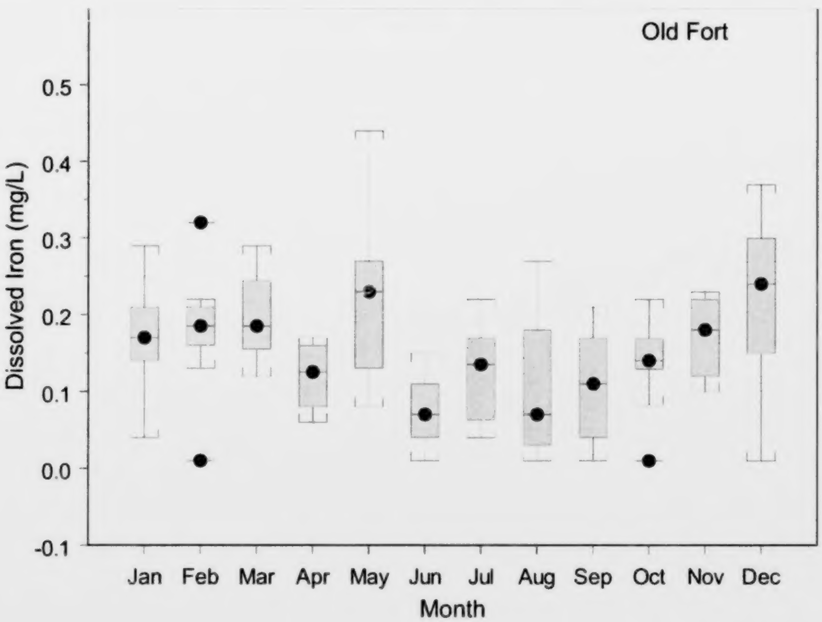
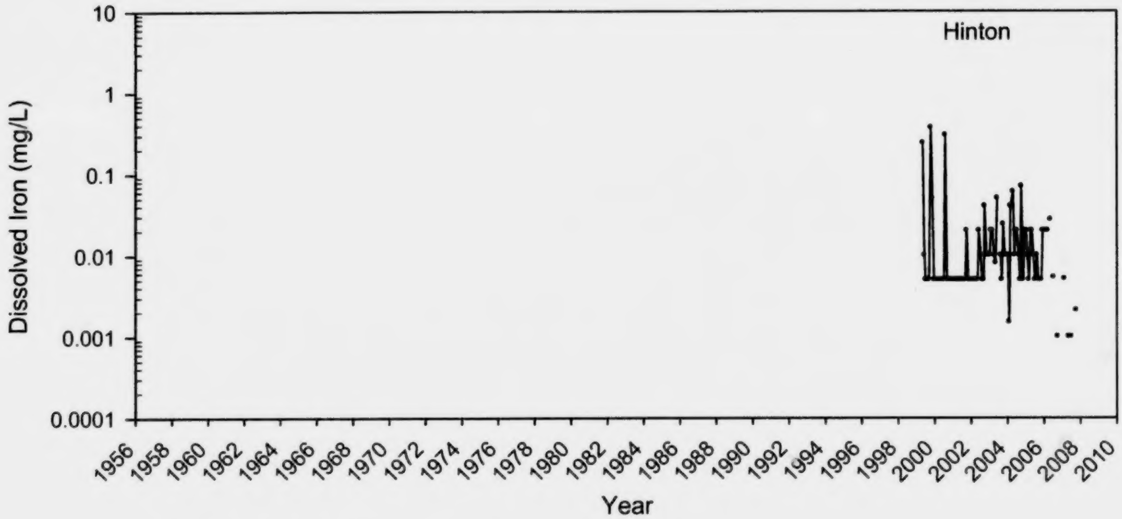
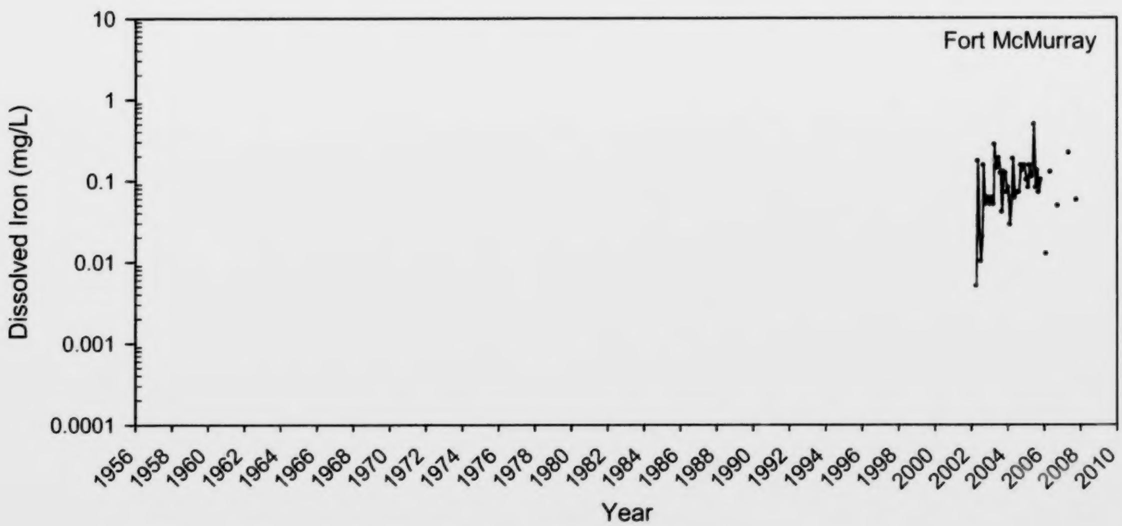


Figure 189 Seasonality of dissolved iron concentration in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0050		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0800		
Flow Adjusted								

Figure 190 Dissolved iron concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

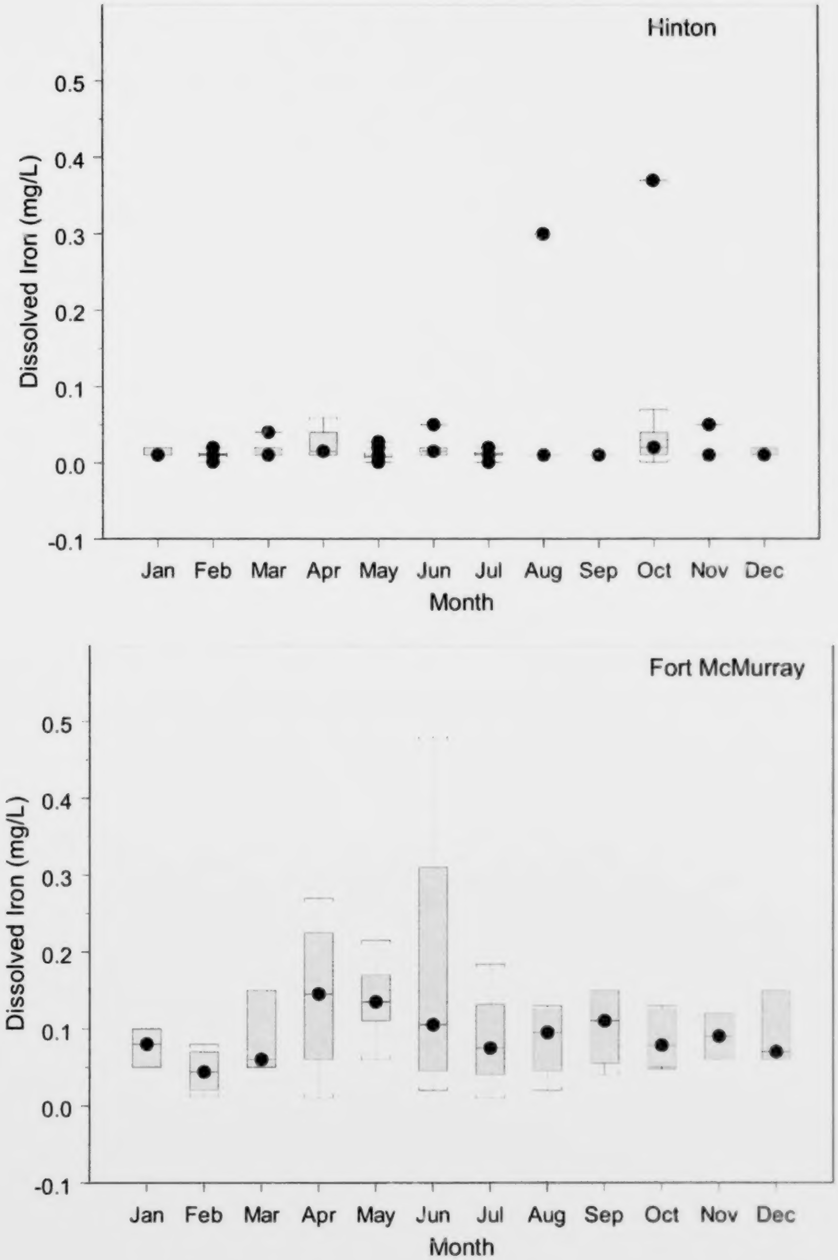
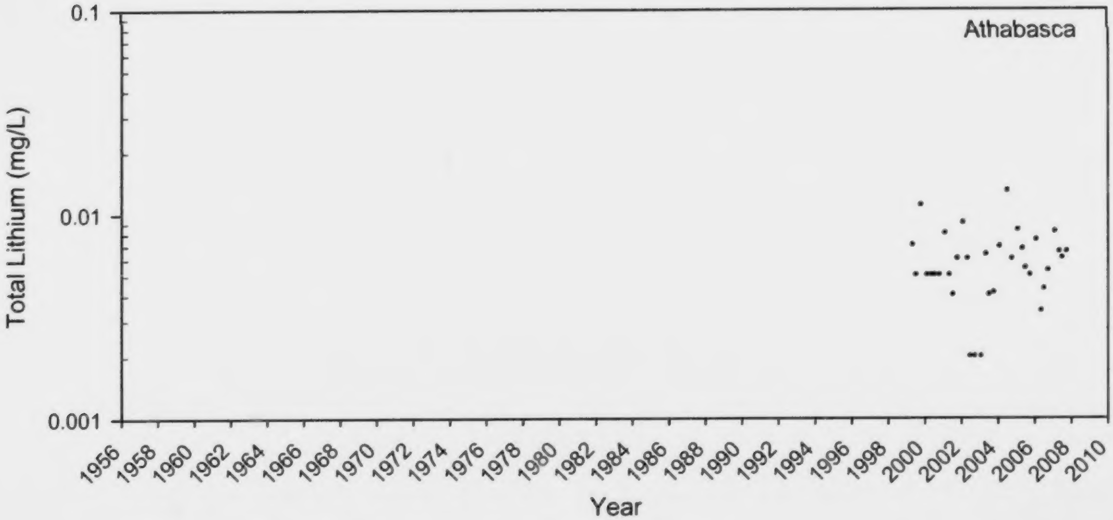
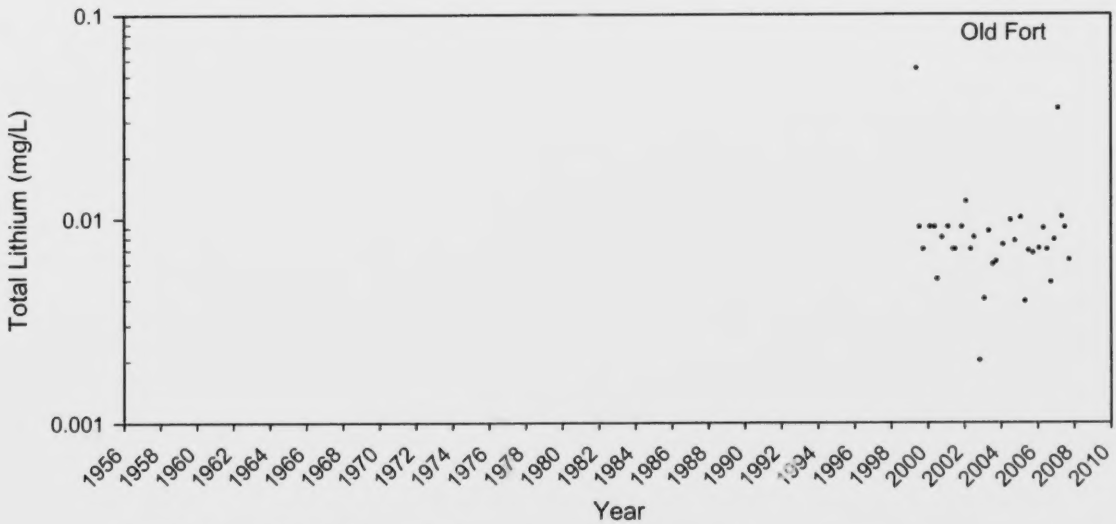


Figure 191 Seasonality of dissolved iron in the Athabasca River at Hinton and Fort McMurray.

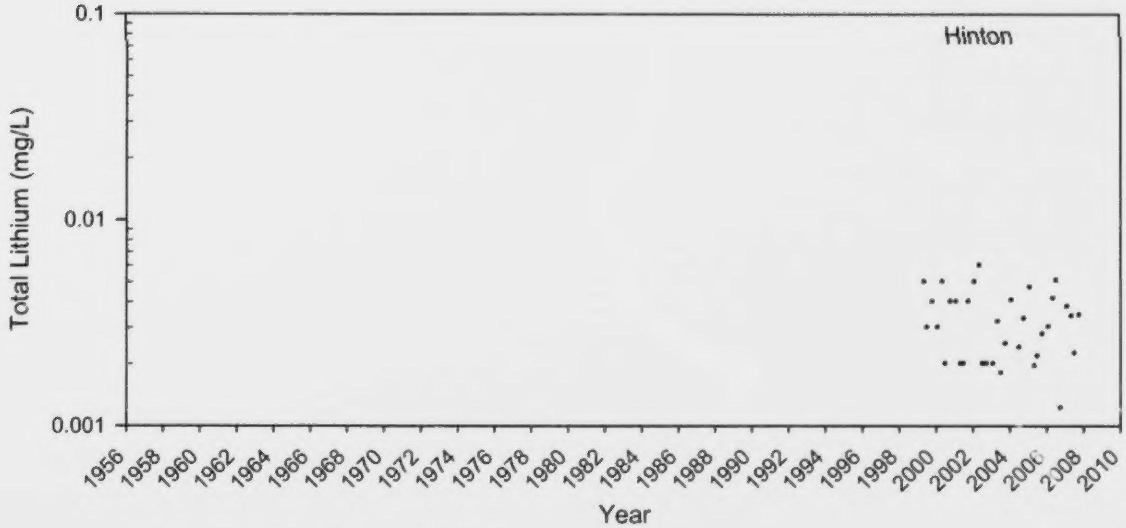


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0057		
Flow Adjusted								

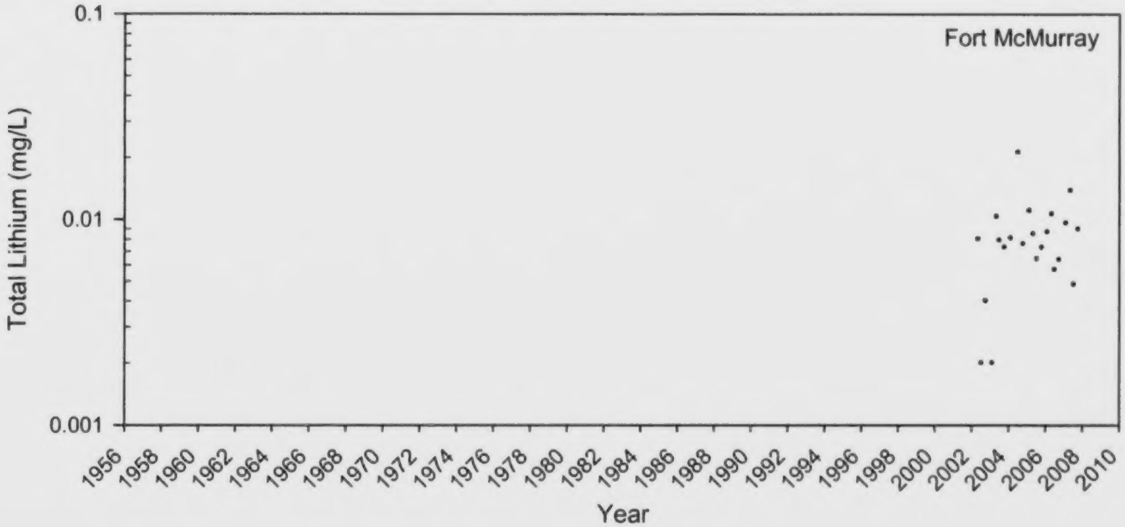


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0077		
Flow Adjusted								

Figure 192 Total lithium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

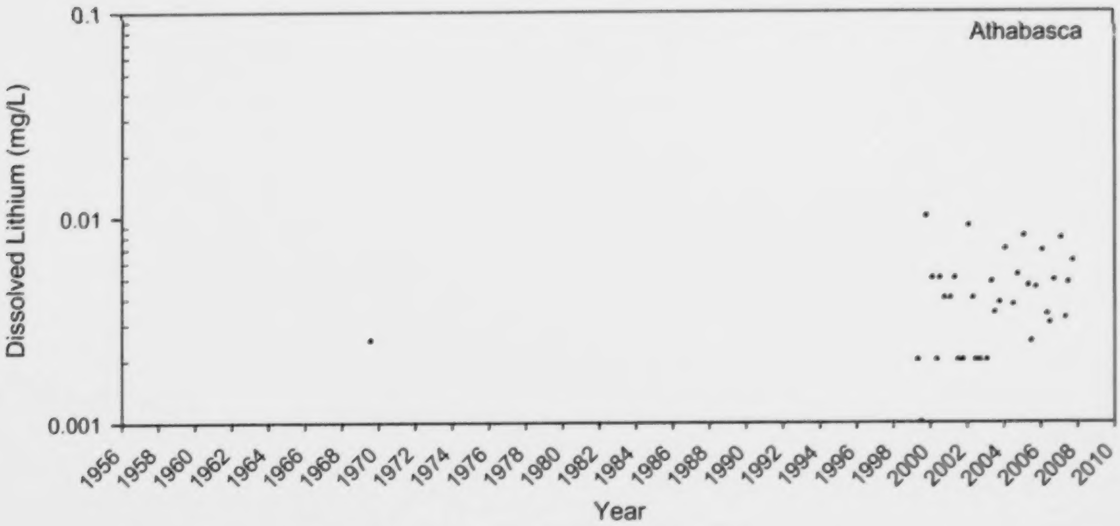


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0030		
Flow Adjusted								

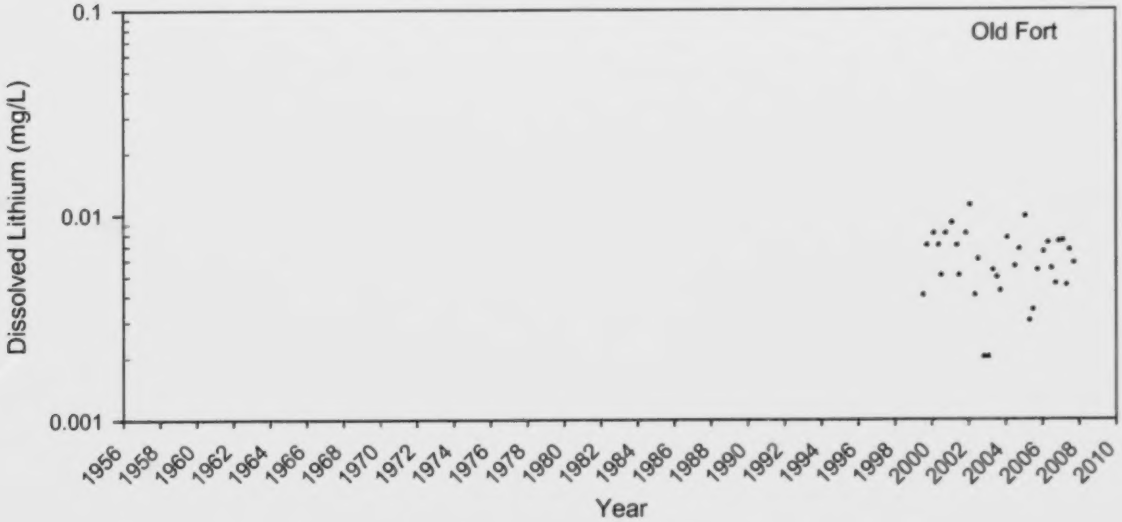


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0080		
Flow Adjusted								

Figure 193 Total lithium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

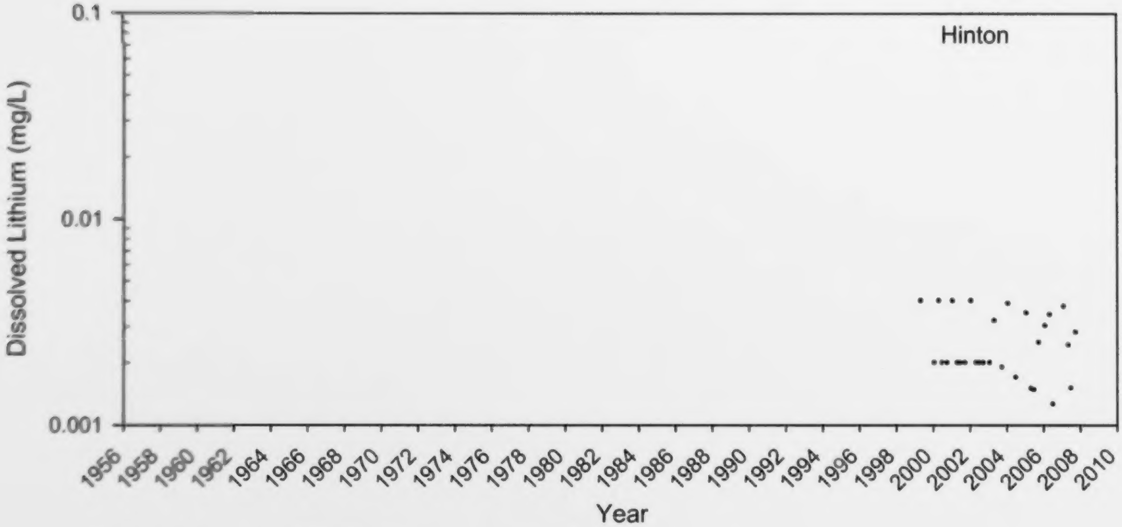


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0040		
Flow Adjusted								

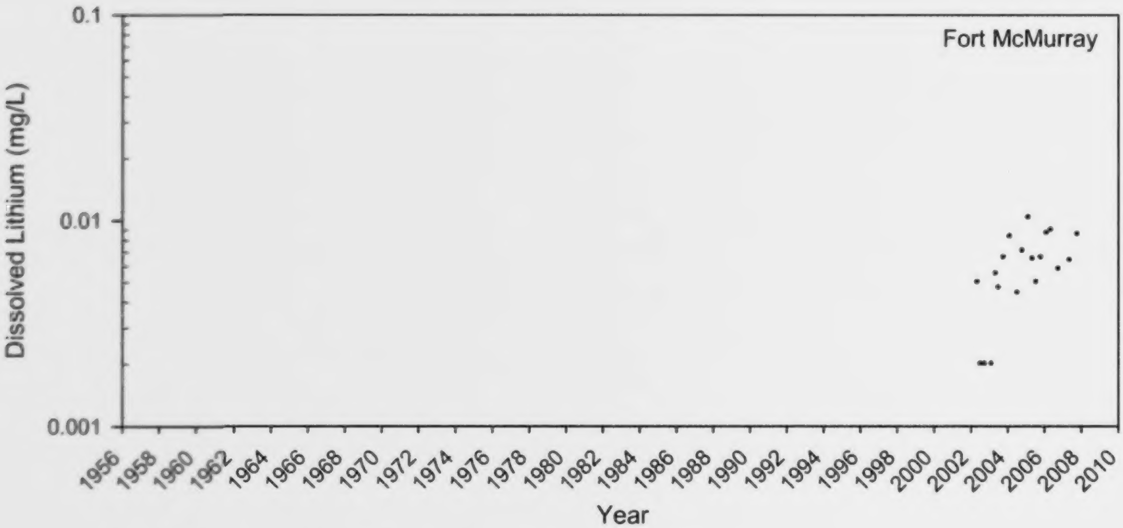


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0059		
Flow Adjusted								

Figure 194 Dissolved lithium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

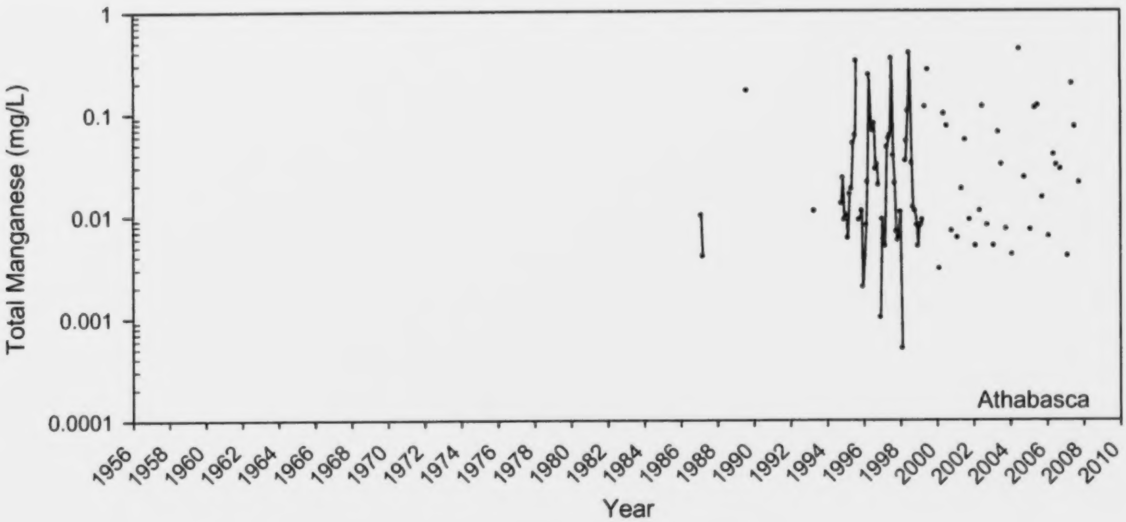


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0020		
Flow Adjusted								

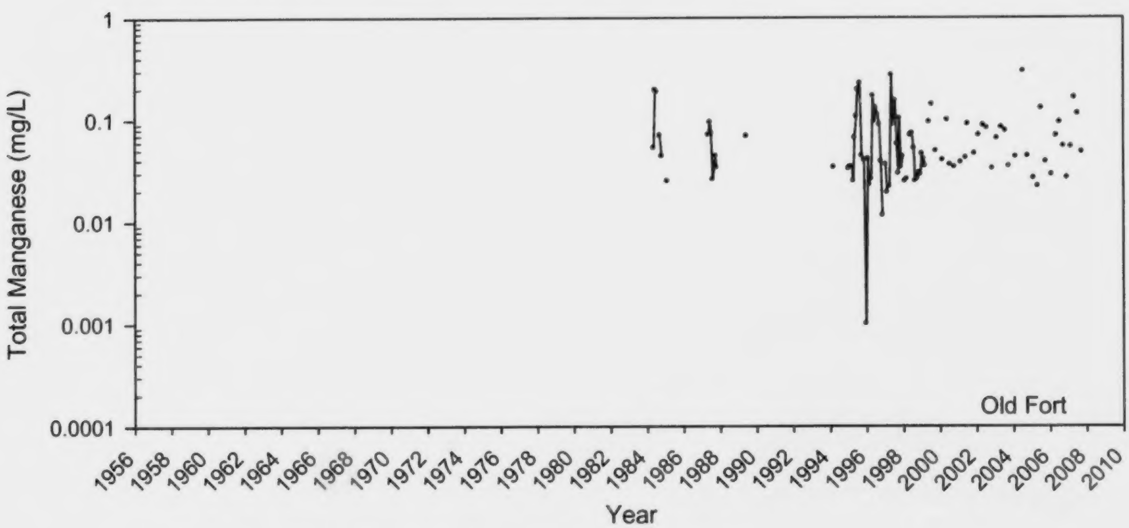


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0064		
Flow Adjusted								

Figure 195 Dissolved lithium in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0189		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0439		
Flow Adjusted								

Figure 196 Total manga nese concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

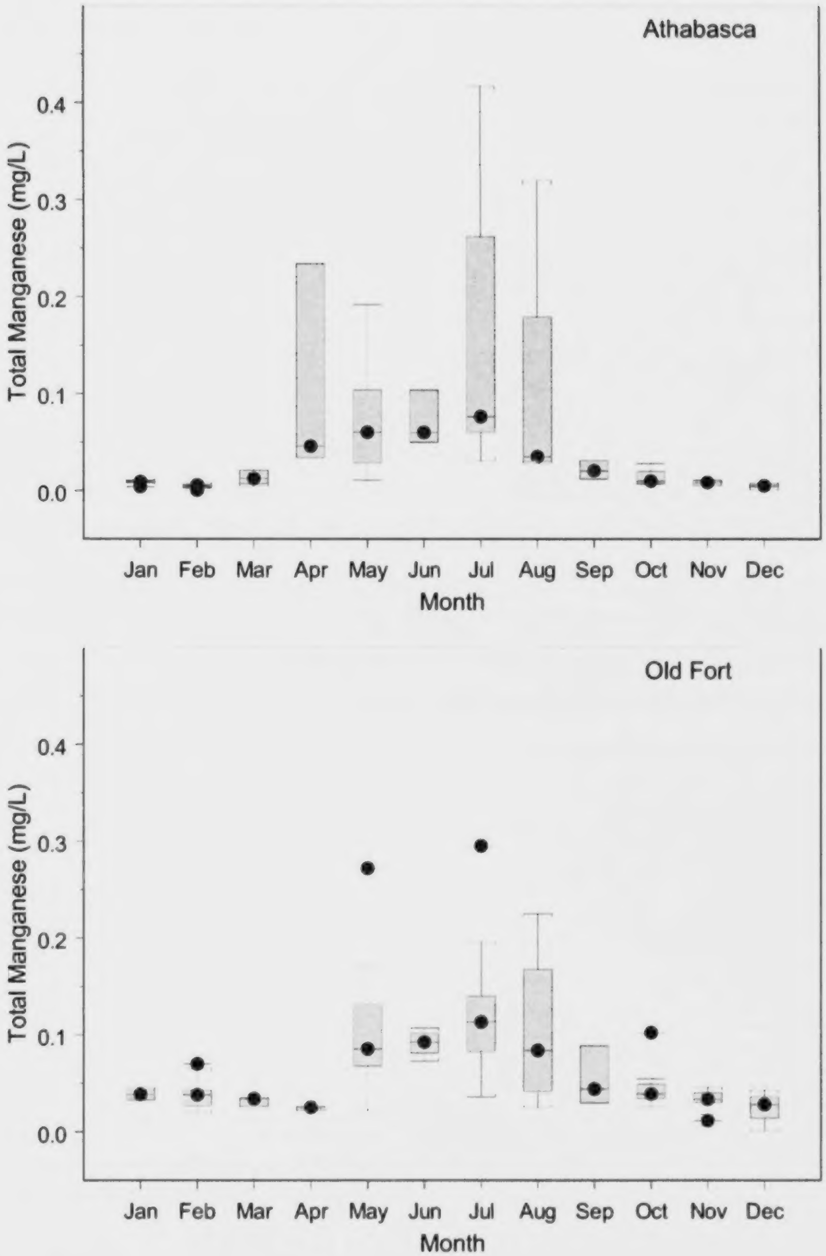
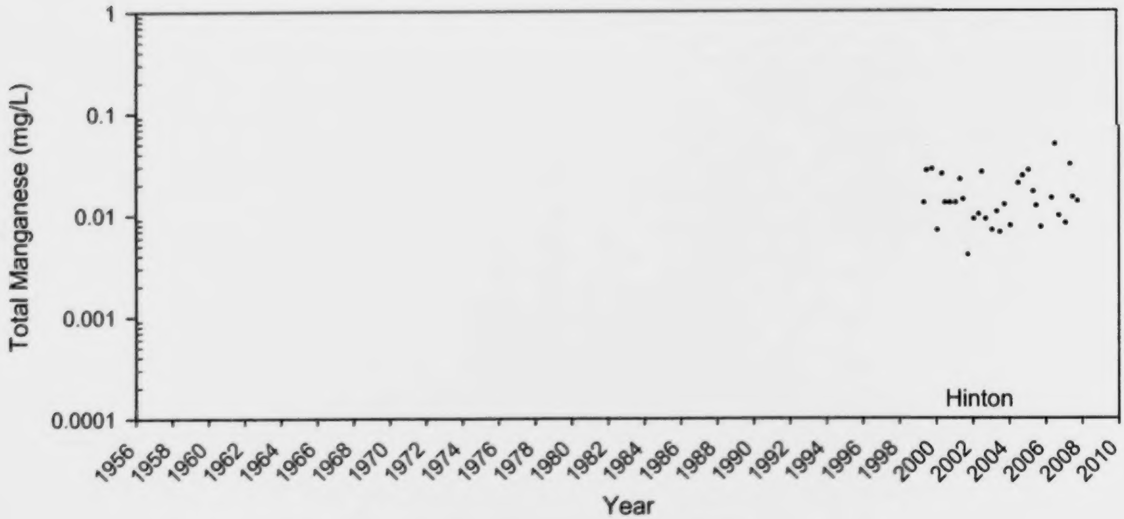
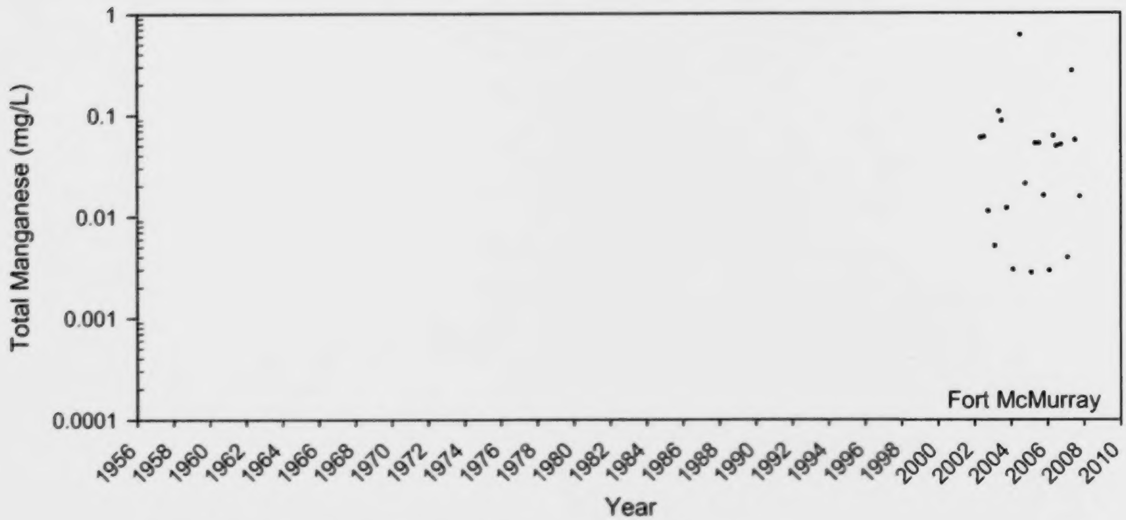


Figure 197 Seasonality of total manganese in the Athabasca River at Athabasca and Old Fort.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0130		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0488		
Flow Adjusted								

Figure 198 Total manganese concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

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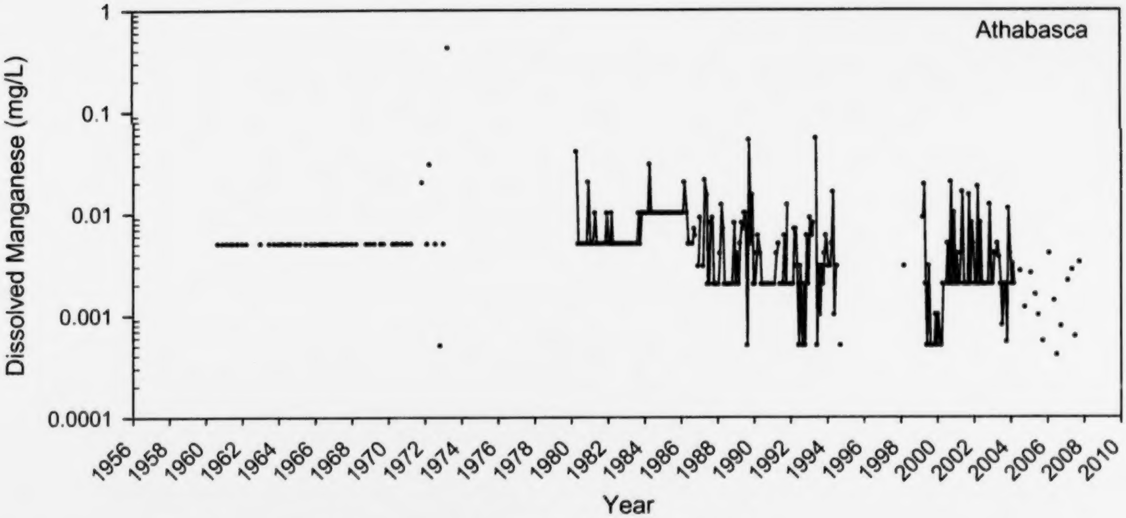
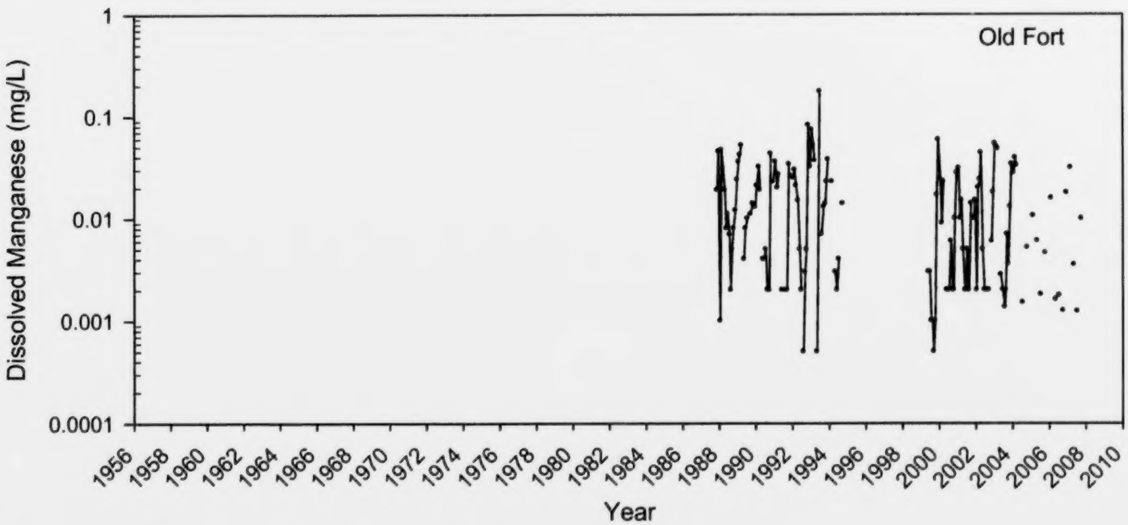


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0020		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0100		
Flow Adjusted								

Figure 199 Dissolved manganese concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

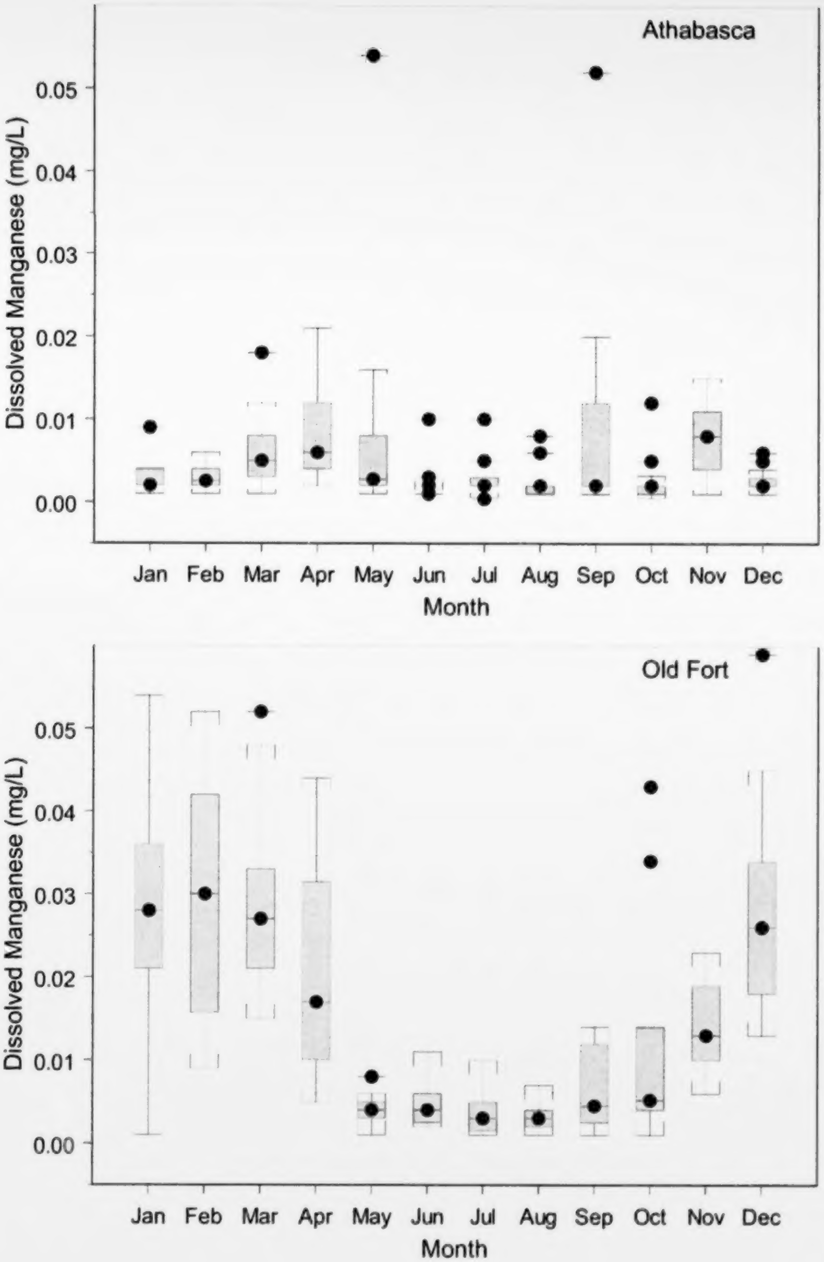
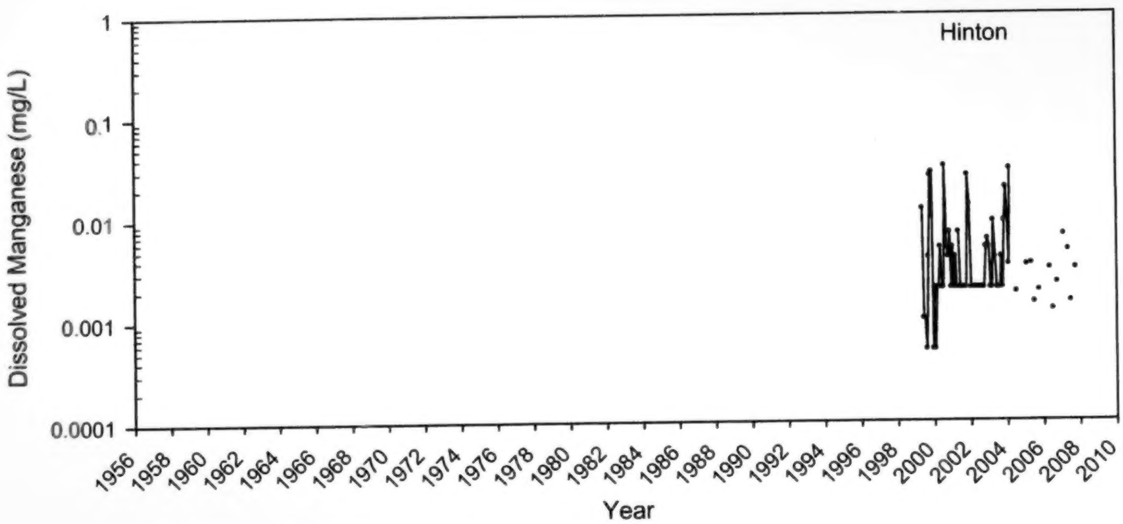
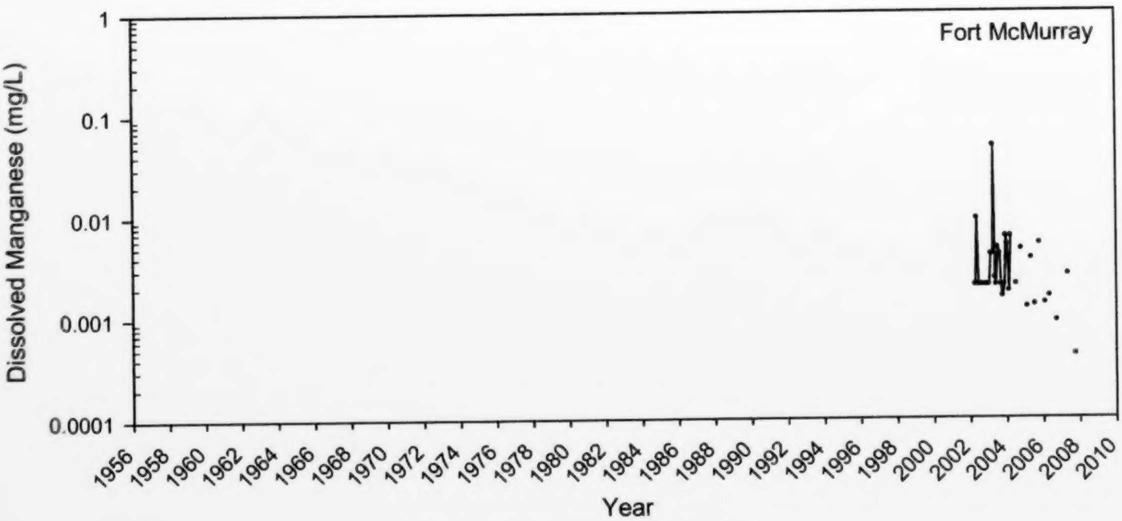


Figure 200 Seasonality of dissolved manganese in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0020		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0020		
Flow Adjusted								

Figure 201 Dissolved manganese concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

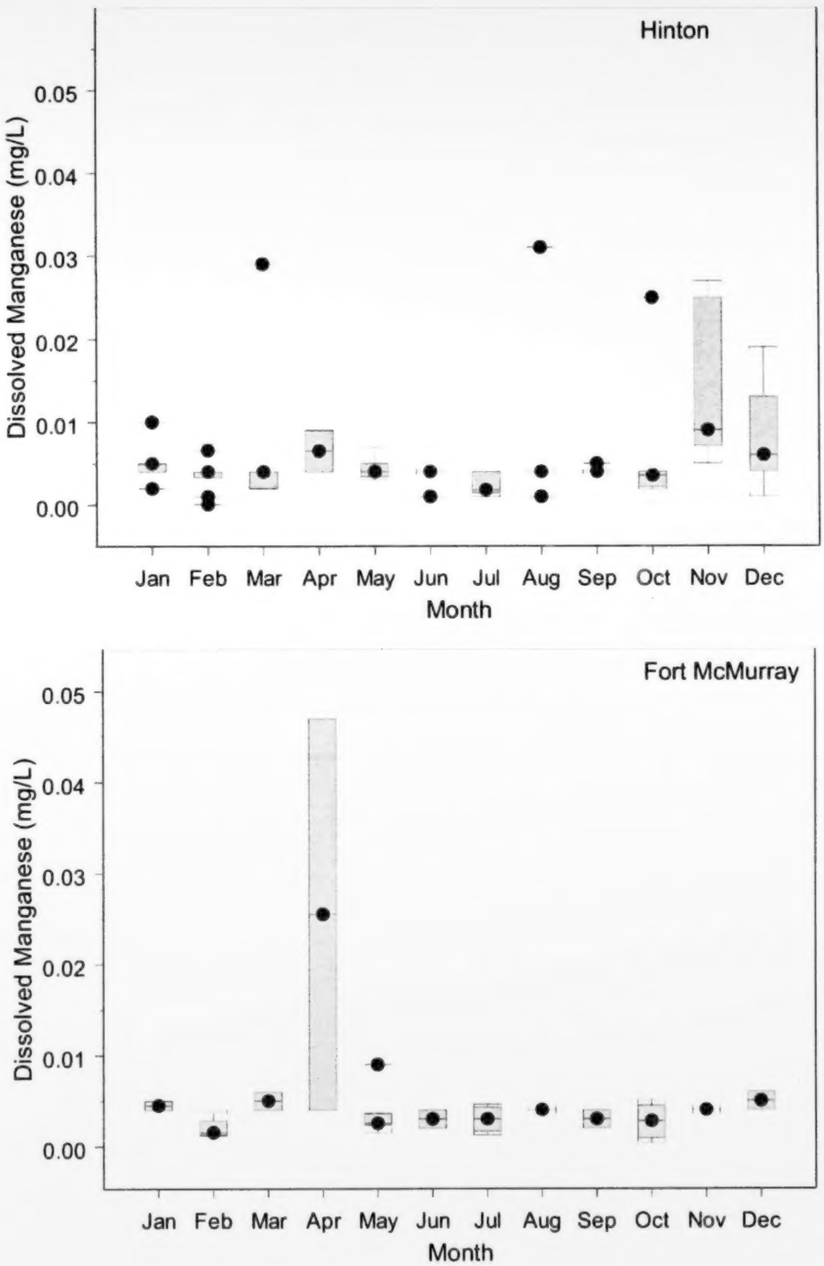
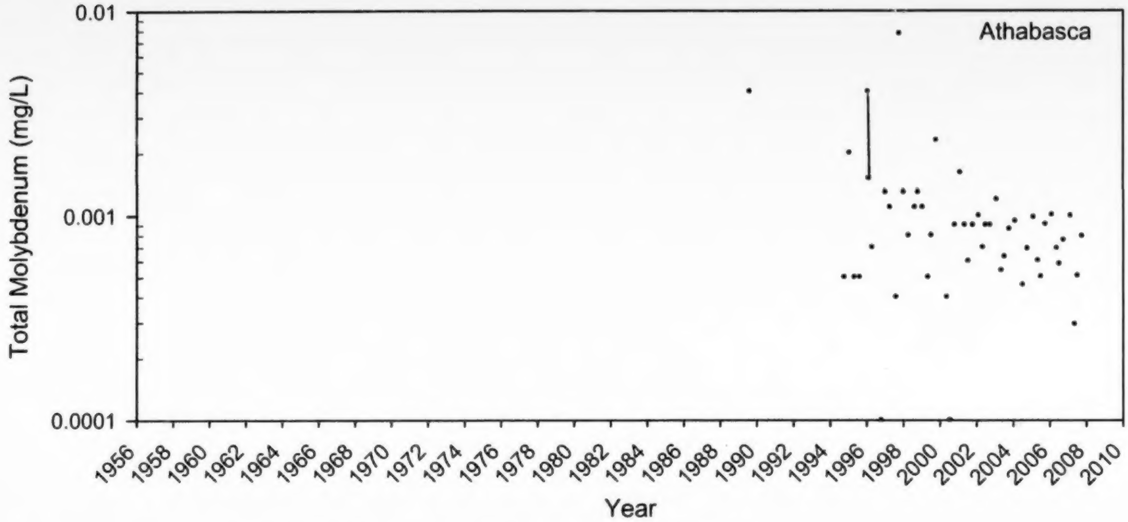
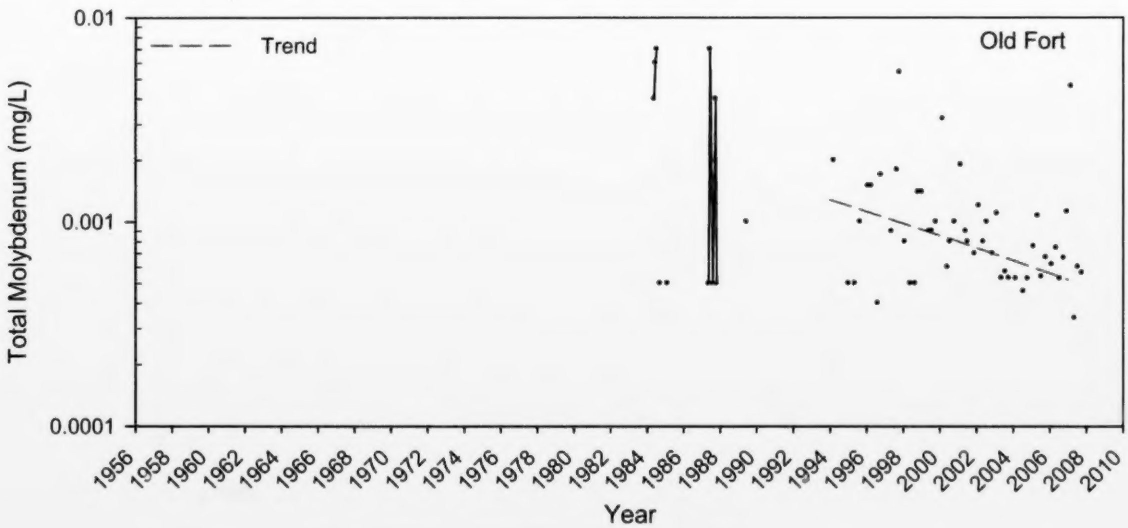


Figure 202 Seasonality of dissolved manganese concentration in the Athabasca River at Hinton and Fort McMurray.

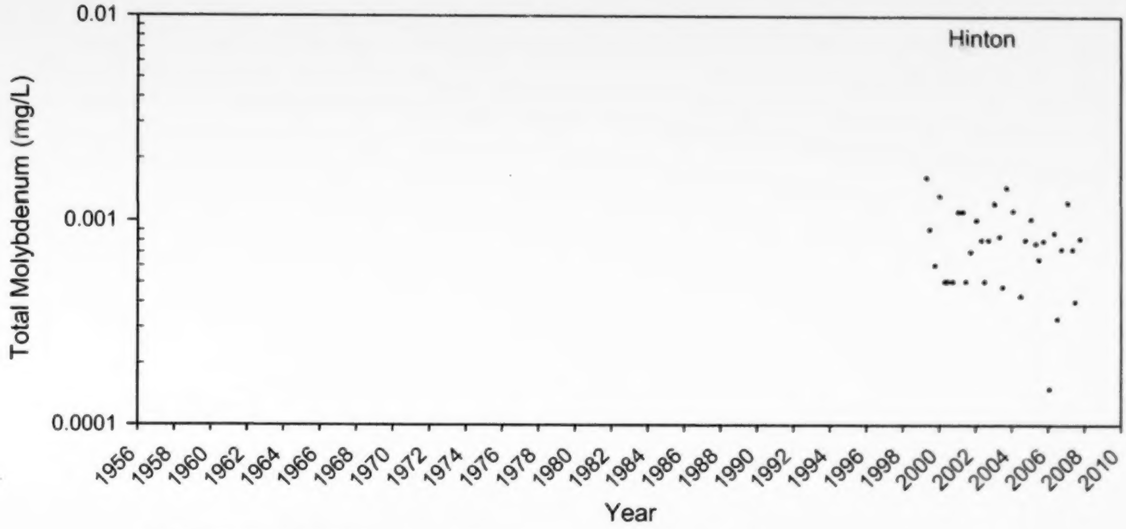


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0009		
Flow Adjusted								

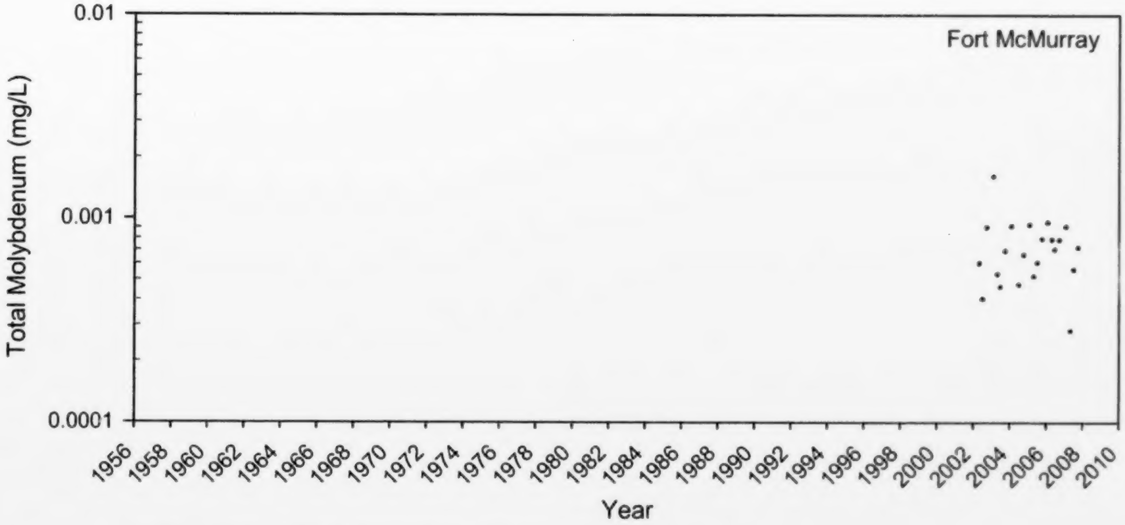


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0008	-0.00006	down
Flow Adjusted								
							-0.00004	none

Figure 203 Total molybdenum concentration in the Athabasca River at Athabasca and Old Fort. Significance of monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). Data for the Athabasca site are inadequate for trend analysis at this time.

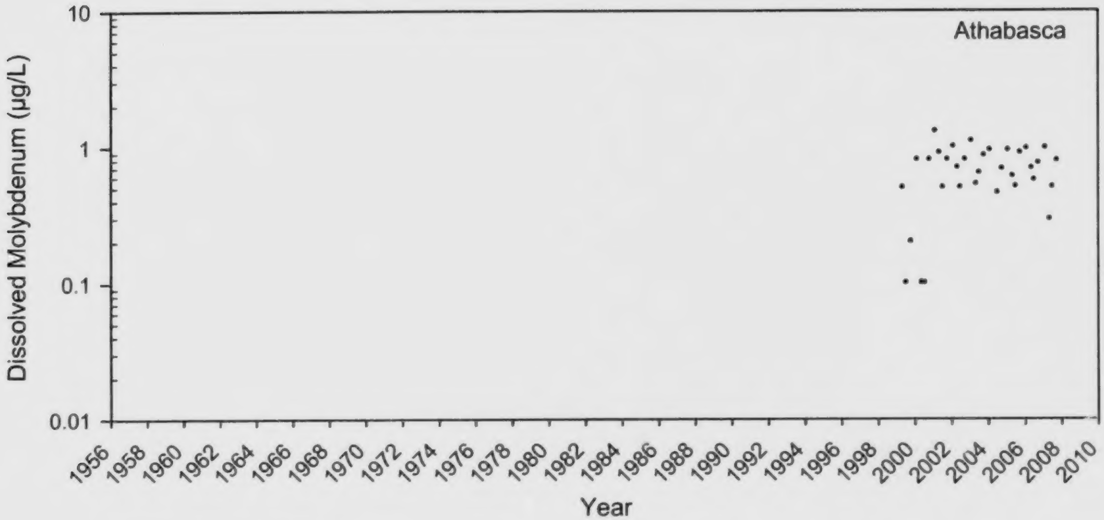


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0008		
Flow Adjusted								

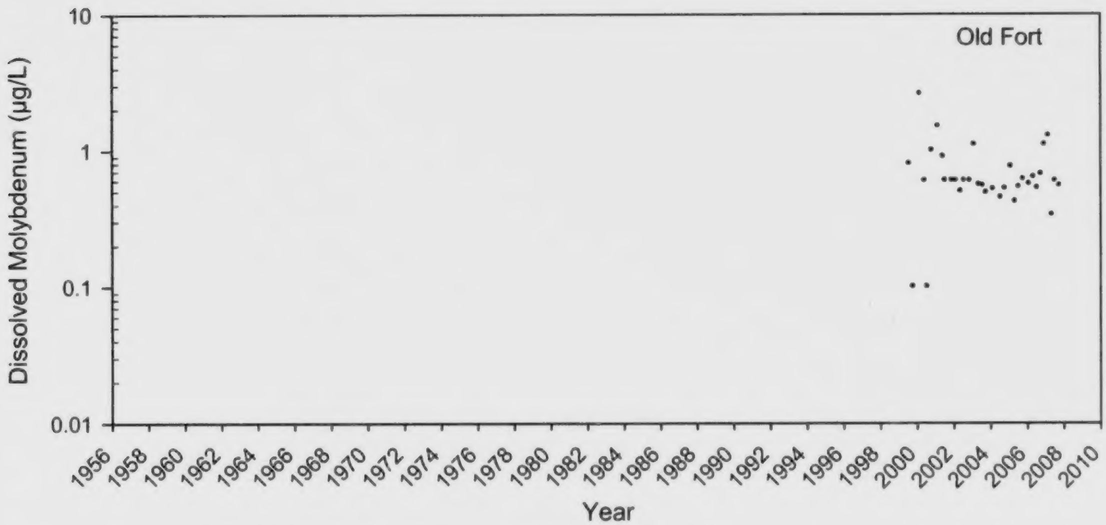


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0007		
Flow Adjusted								

Figure 204 Total molybdenum concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

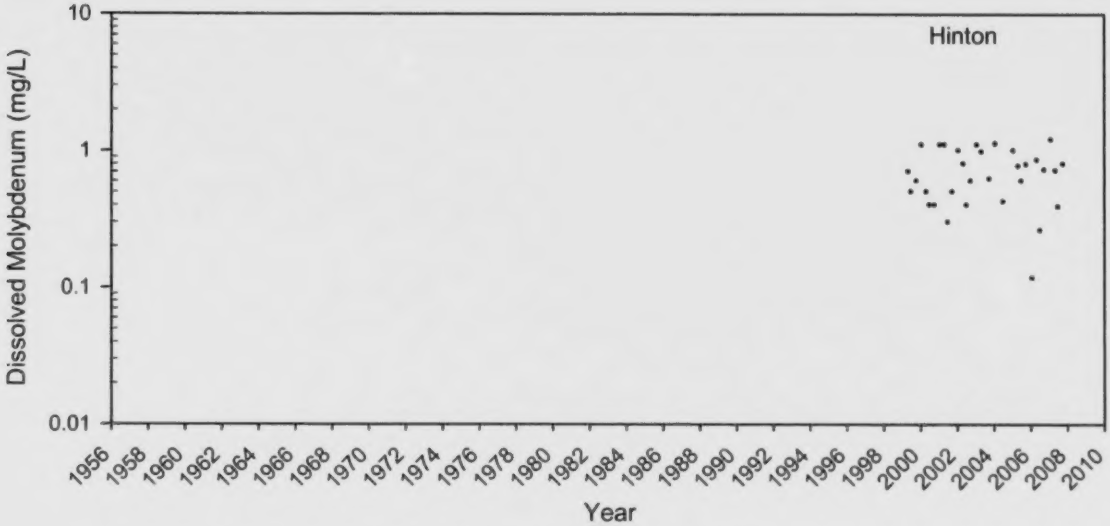


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.7550		
Flow Adjusted								

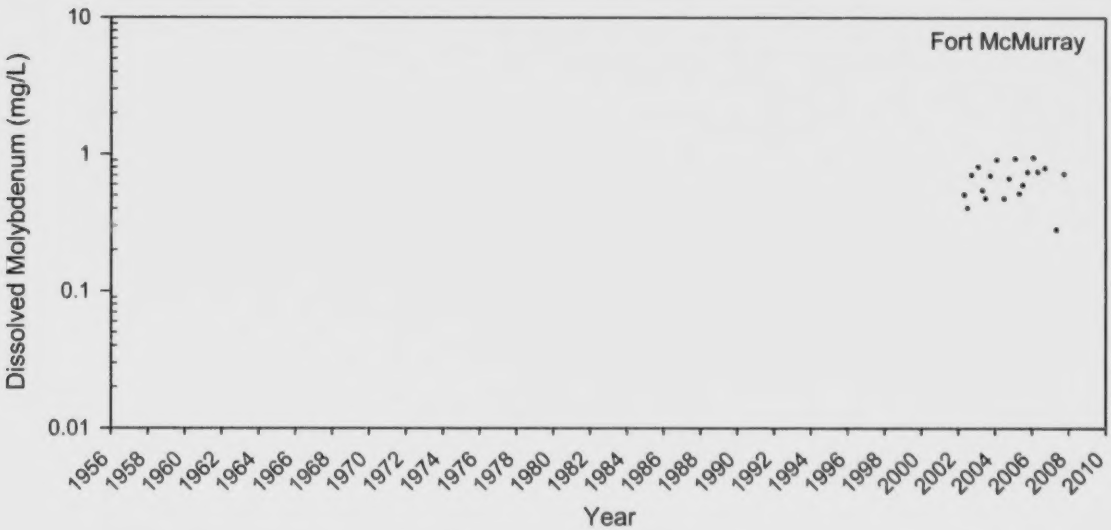


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.6000		
Flow Adjusted								

Figure 205 Dissolved molybdenum concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

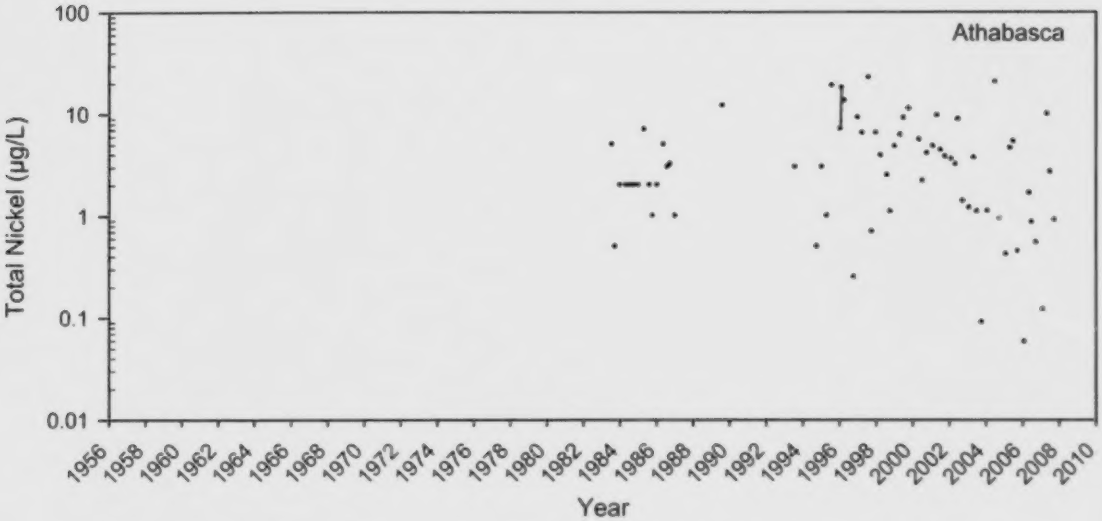


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						7.22E-04		
Flow Adjusted								

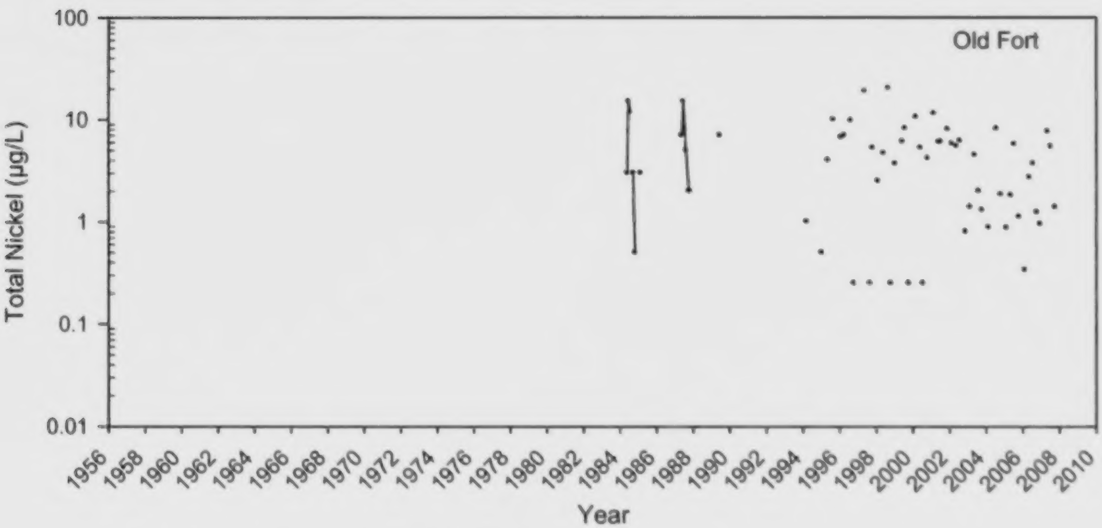


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						6.90E-04		
Flow Adjusted								

Figure 206 Dissolved molybdenum concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

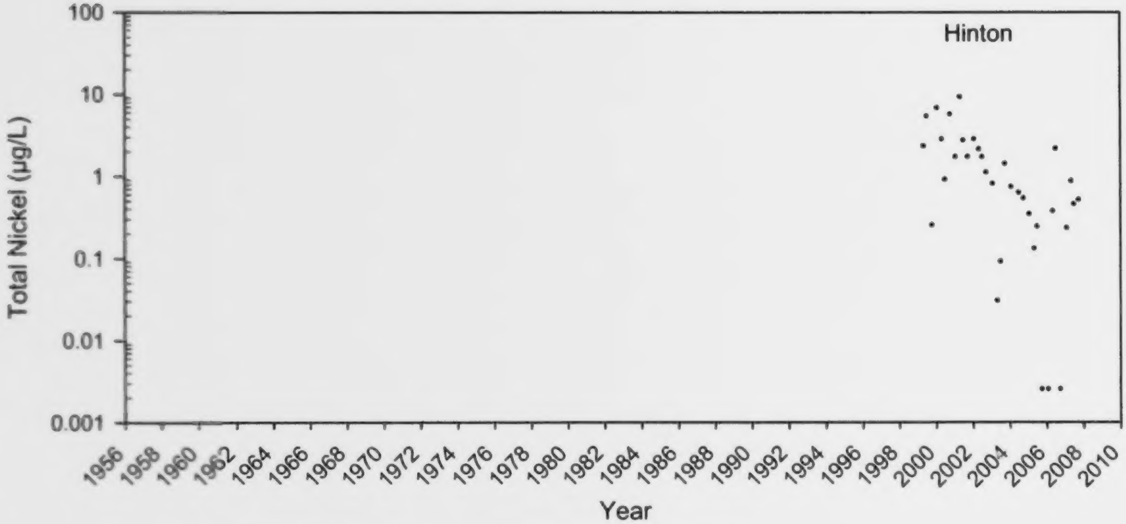


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						3.70		
Flow Adjusted								

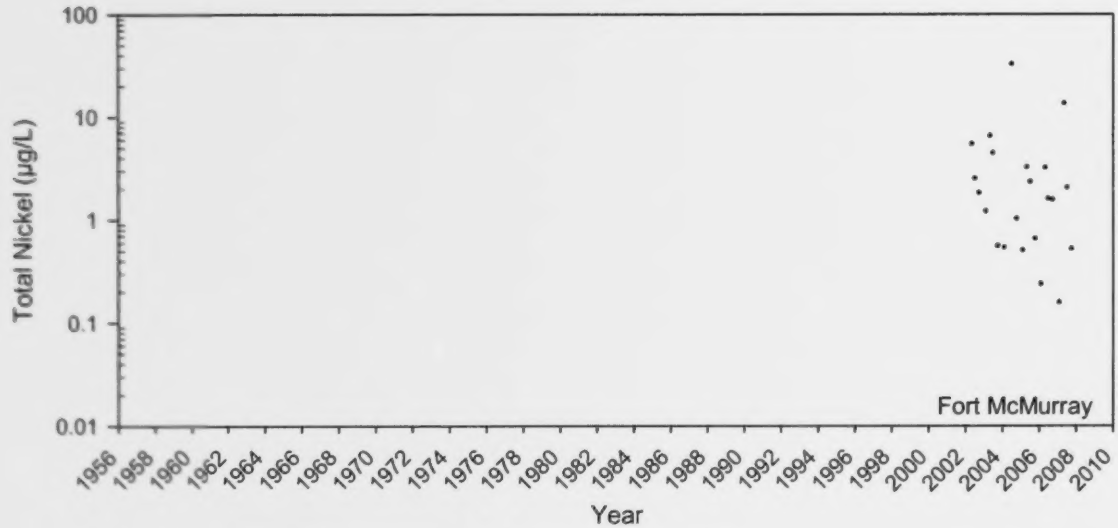


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						4.10		
Flow Adjusted								

Figure 207 Total nickel concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

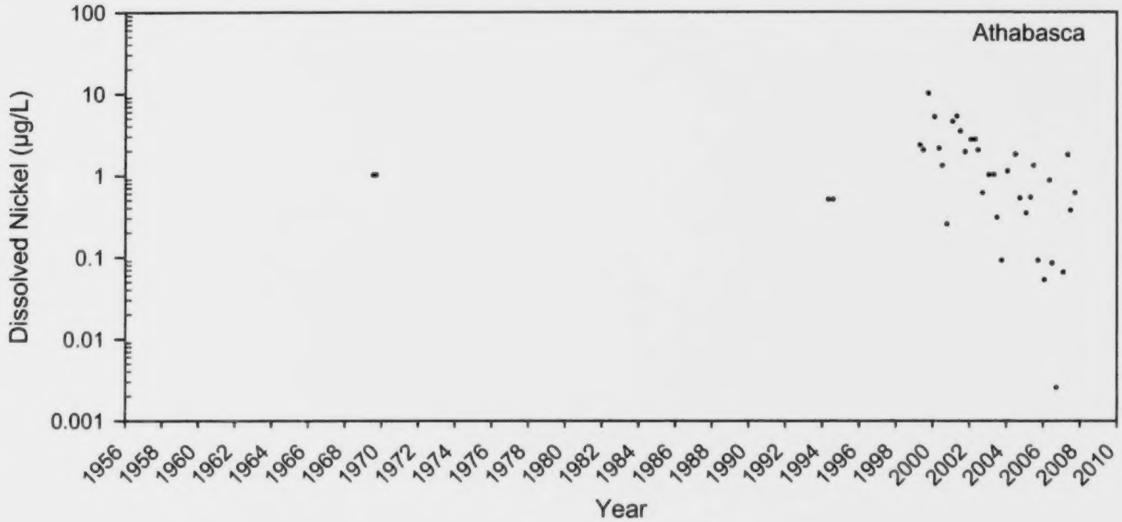


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.80		
Flow Adjusted								

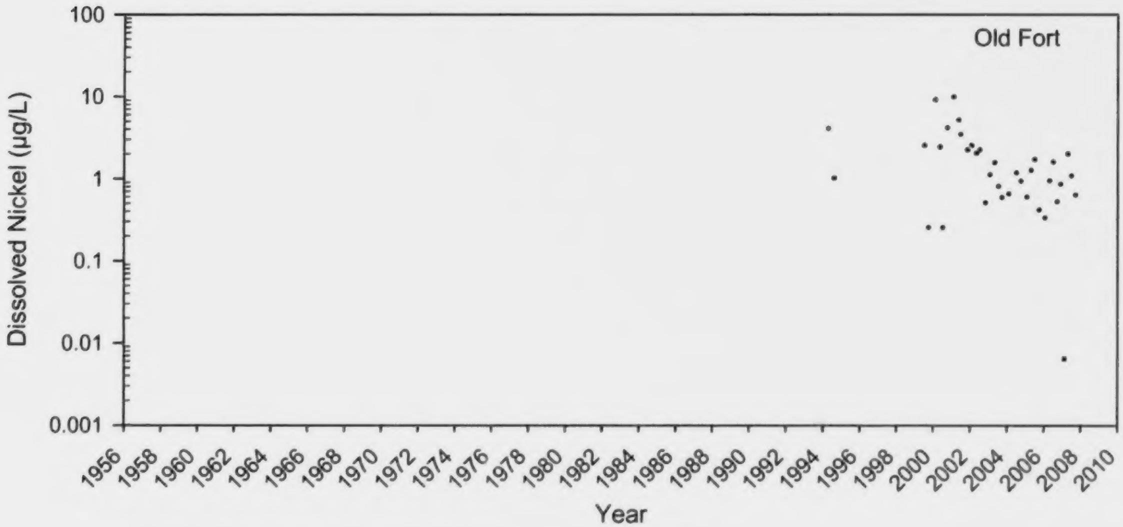


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						1.70		
Flow Adjusted								

Figure 208 Total nickel concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

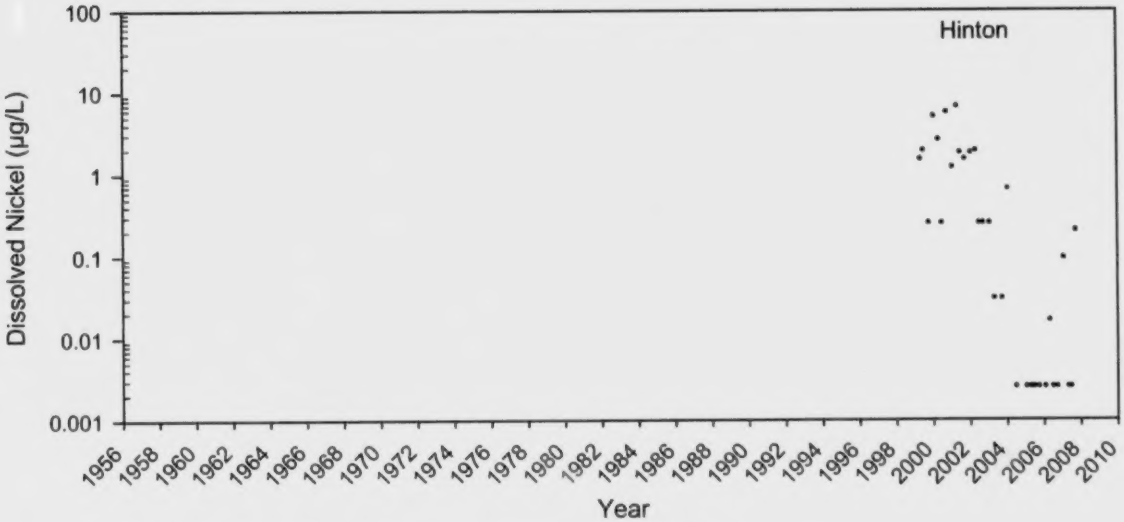


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						1.00		
Flow Adjusted								

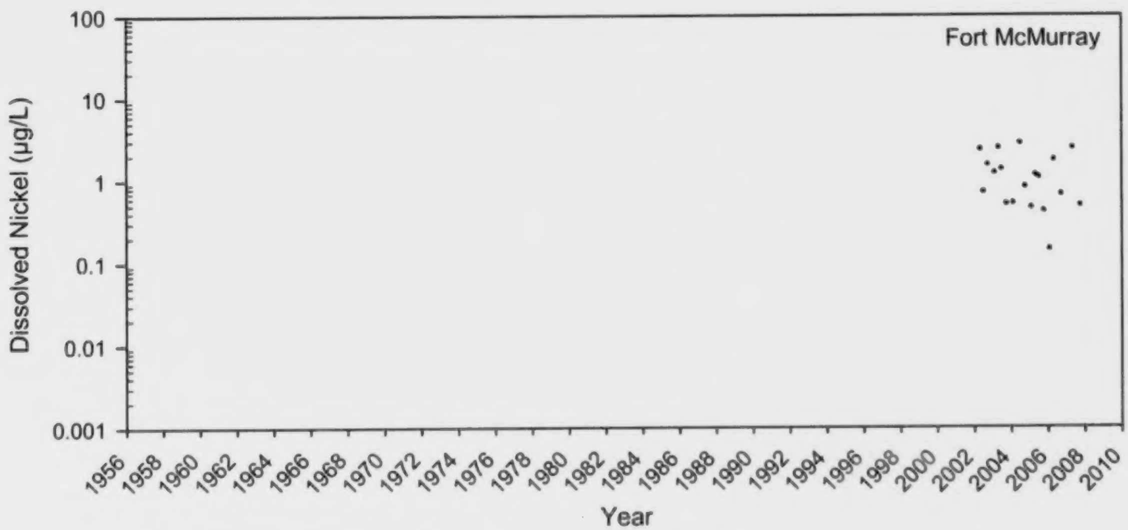


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						1.13		
Flow Adjusted								

Figure 209 Dissolved nickel concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

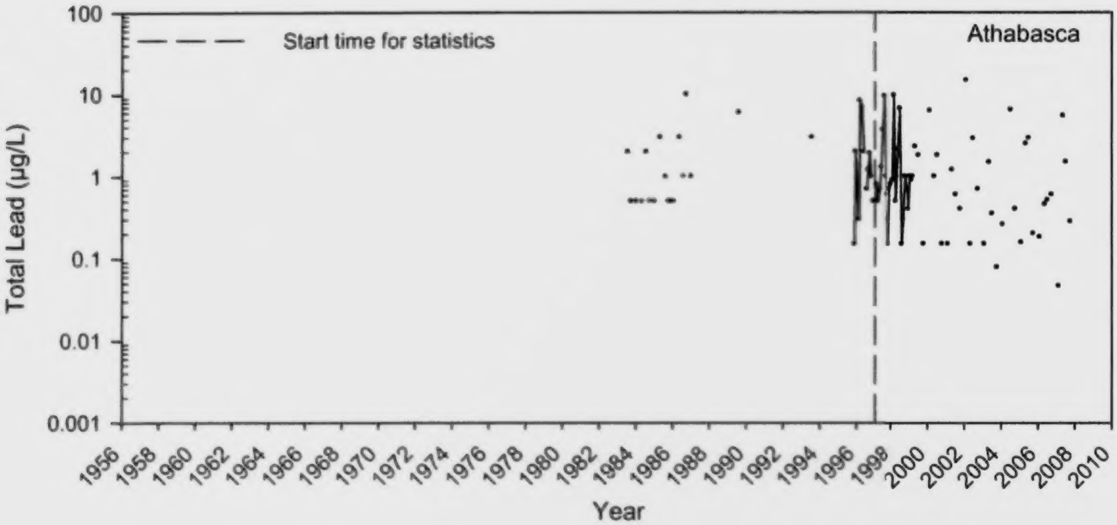


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.20		
Flow Adjusted								

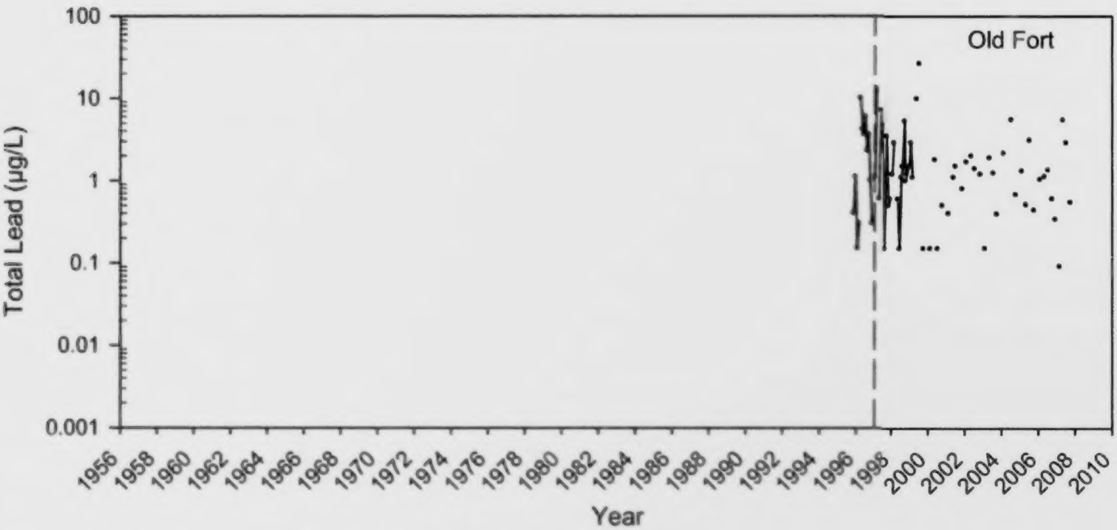


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						1.06		
Flow Adjusted								

Figure 210 Dissolved nickel concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

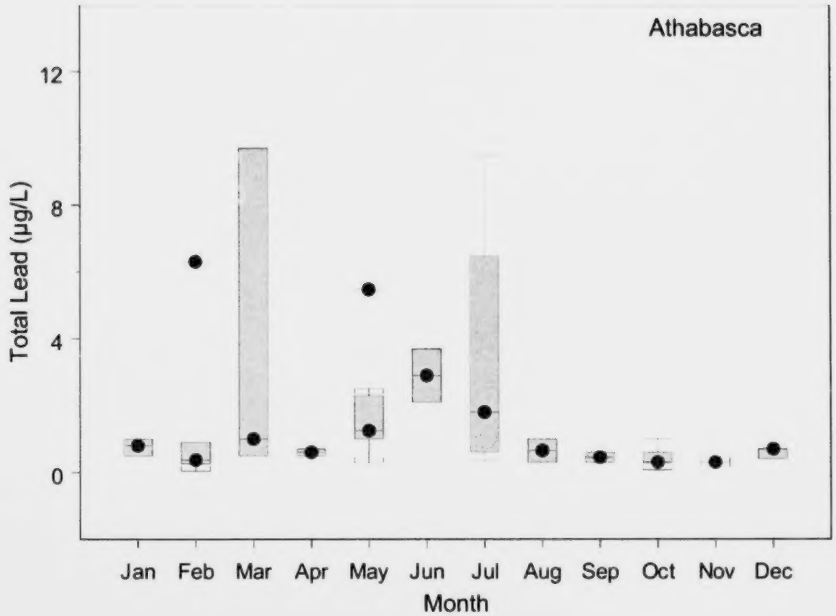


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.70	0.01300	none
Flow Adjusted								
							-0.05130	none



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						1.20	-0.01250	none
Flow Adjusted								
							-0.02853	none

Figure 211 Total lead concentration in the Athabasca River at Athabasca and Old Fort. Significance of monotonic trends was determined at a 95% confidence interval (i.e., $p<0.05$). Hashed vertical line represents begin of analysed data.



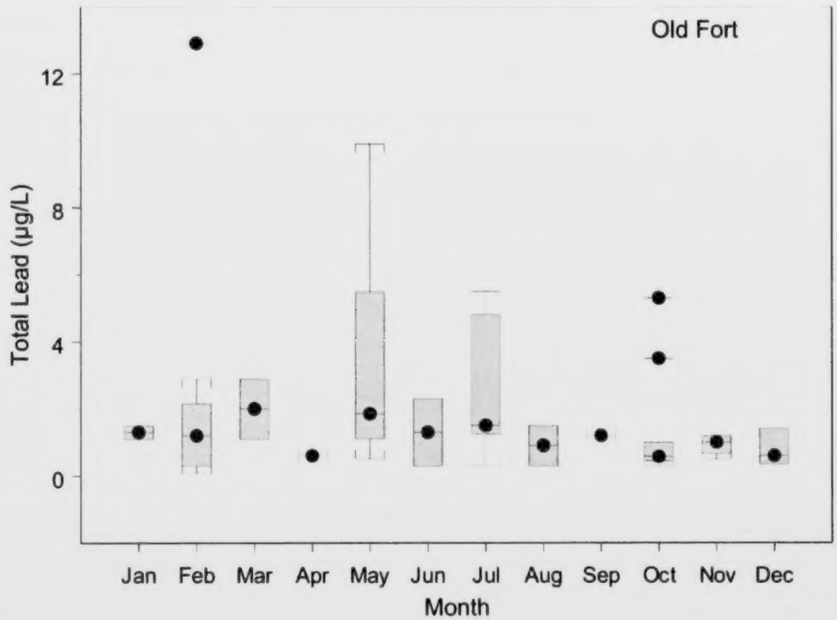
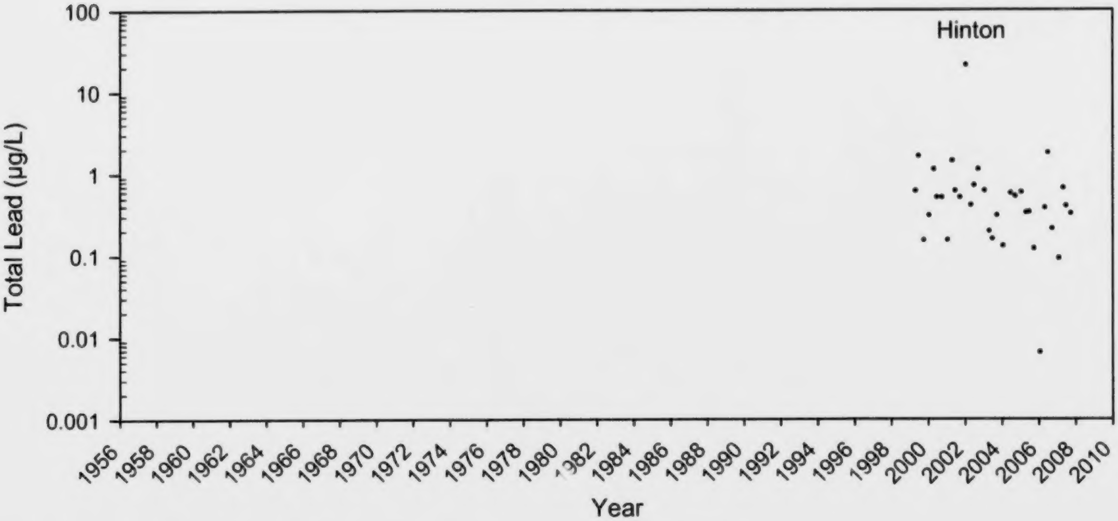
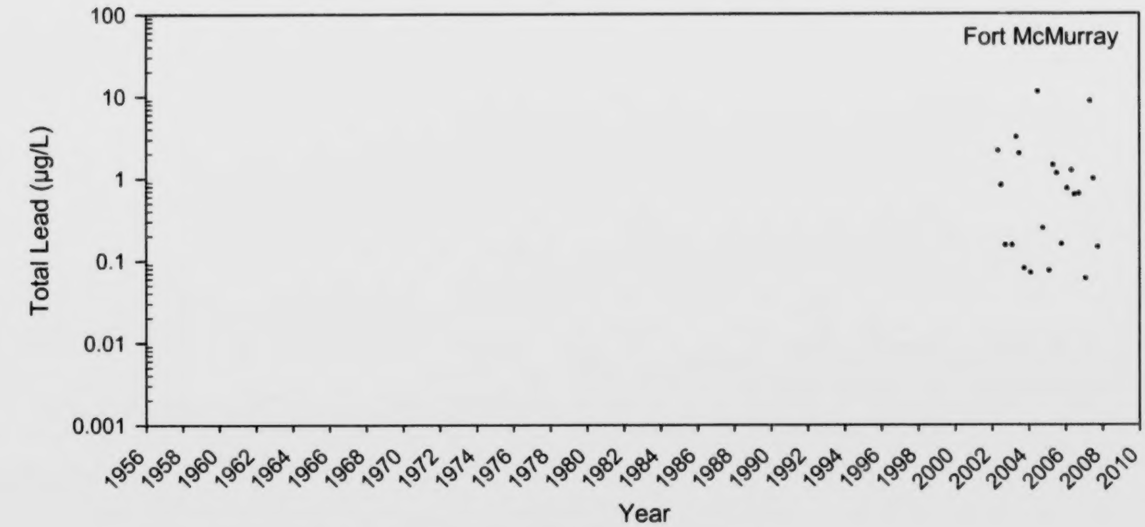


Figure 212 Seasonality of total lead in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.

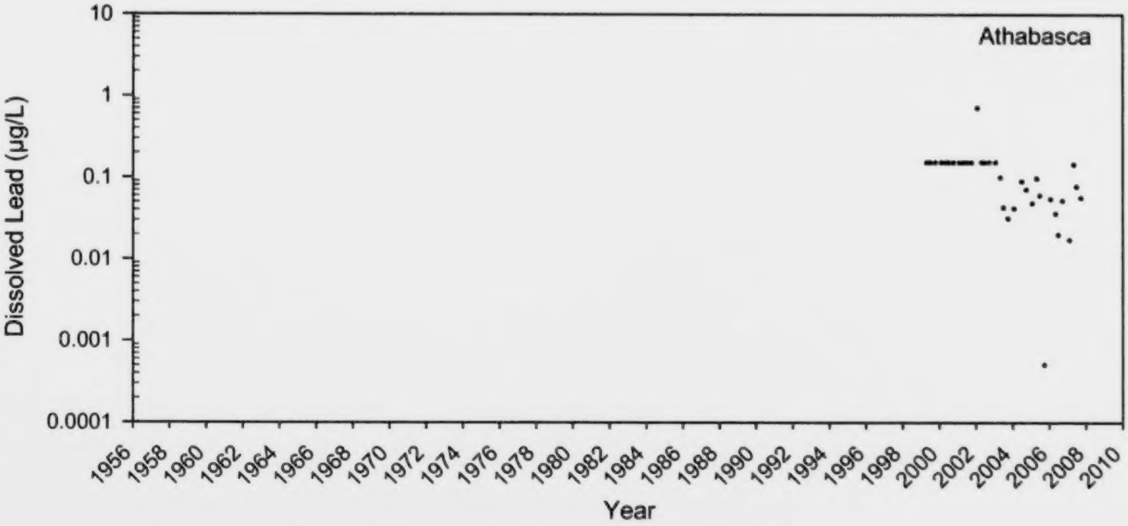


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.40		
Flow Adjusted								

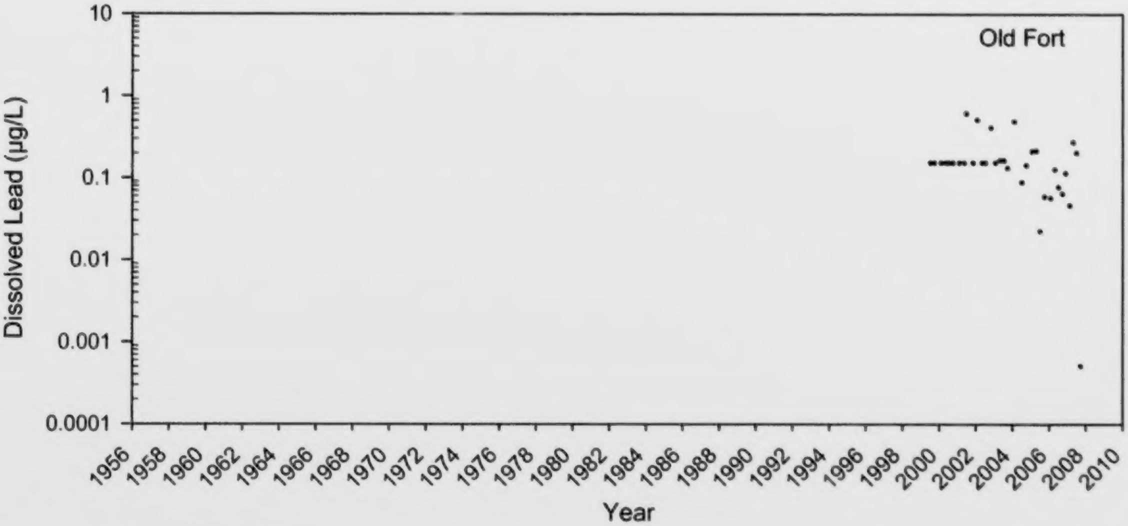


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.68		
Flow Adjusted								

Figure 213 Total lead concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

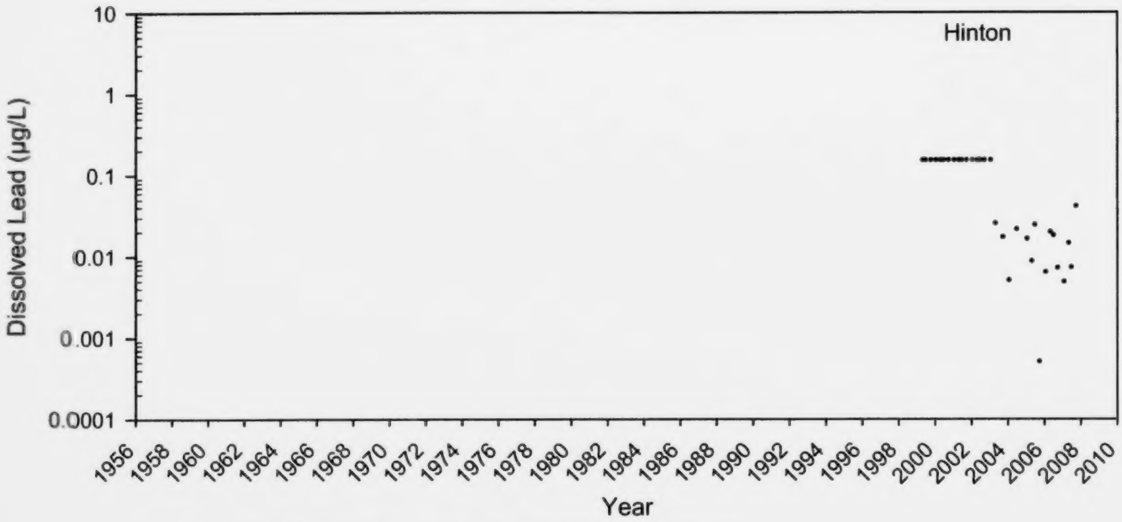


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0536		
Flow Adjusted								

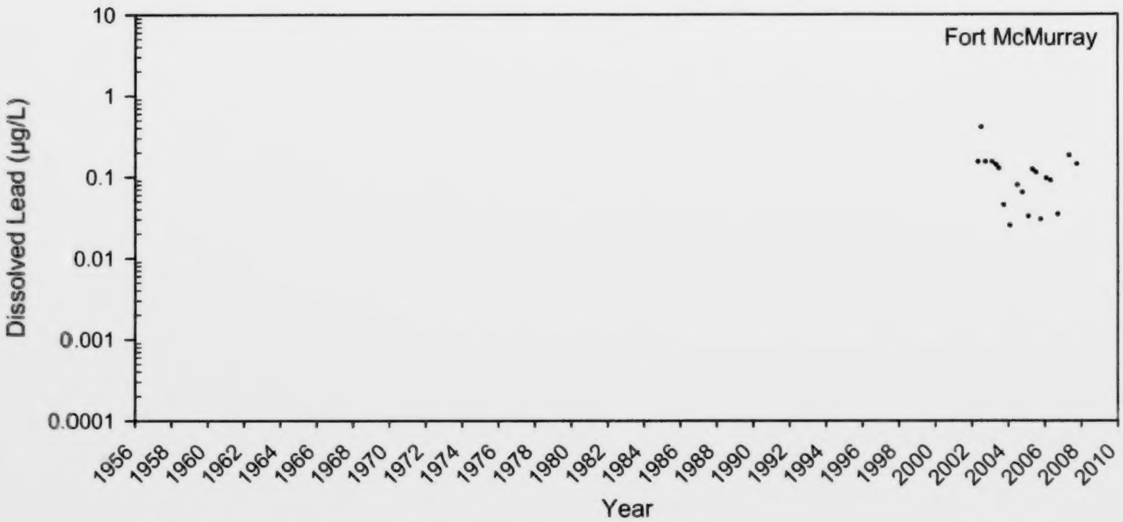


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.1270		
Flow Adjusted								

Figure 214 Dissolved lead concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

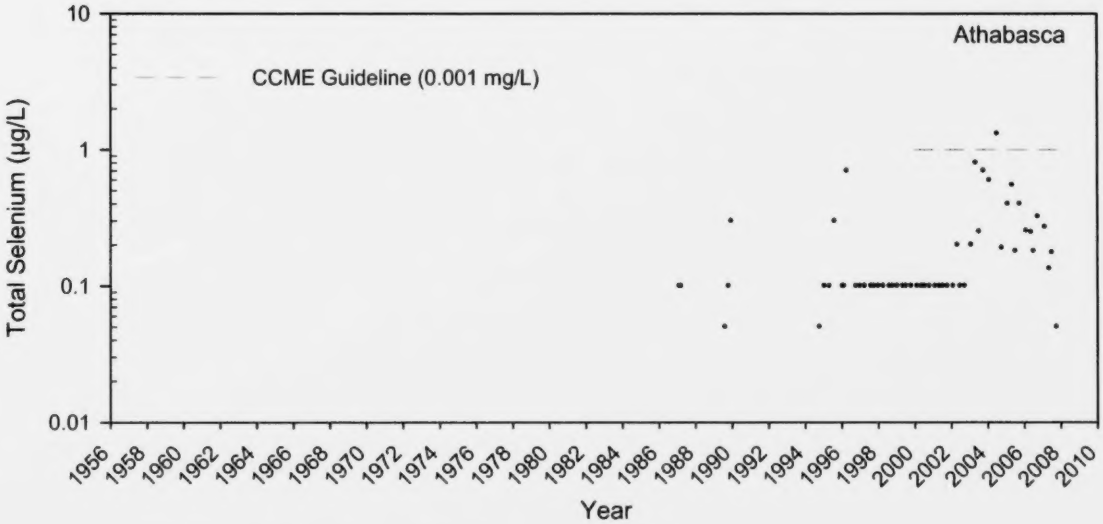


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0162		
Flow Adjusted								

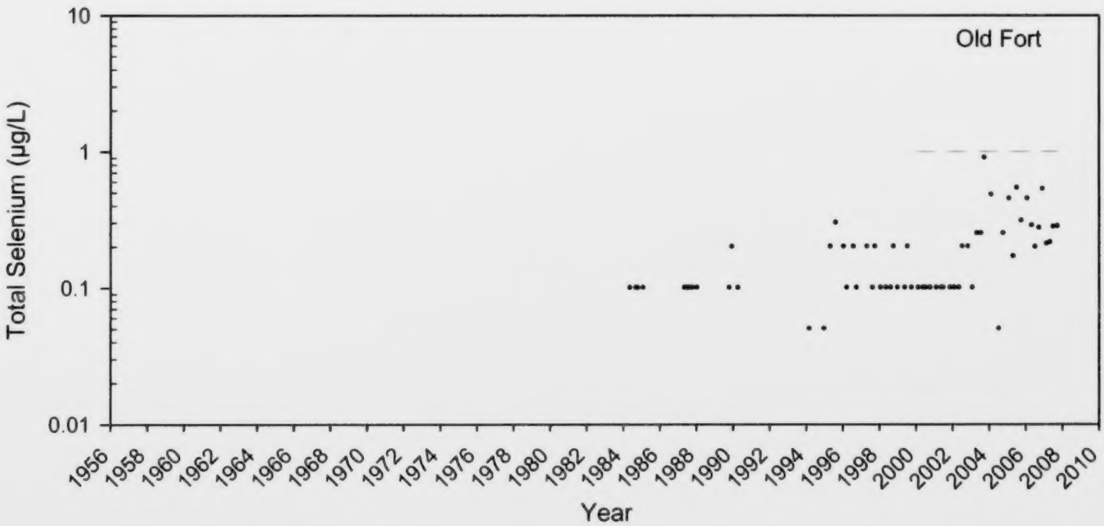


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0912		
Flow Adjusted								

Figure 215 Dissolved lead concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

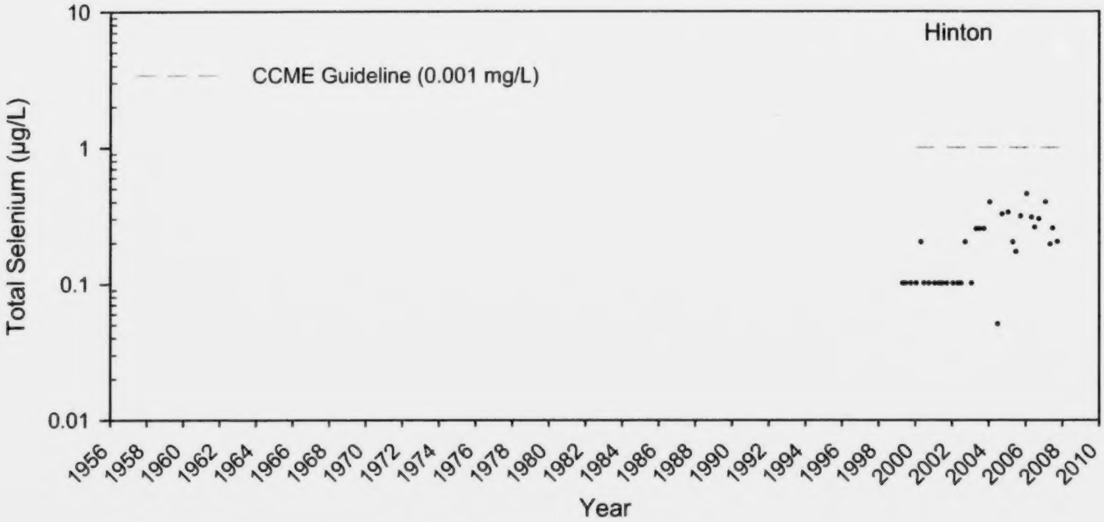


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.254		
Flow Adjusted								

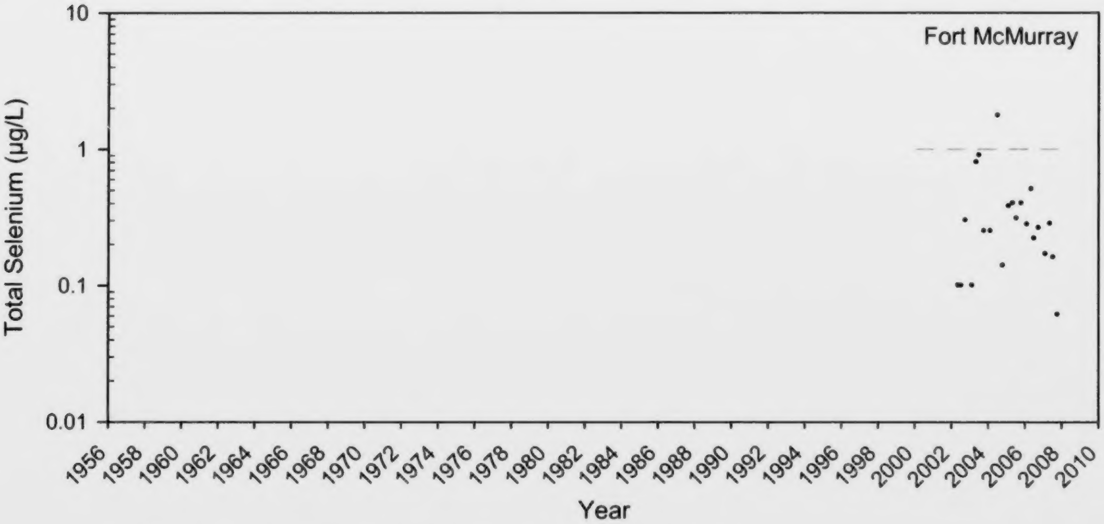


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.277		
Flow Adjusted								

Figure 216 Total selenium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

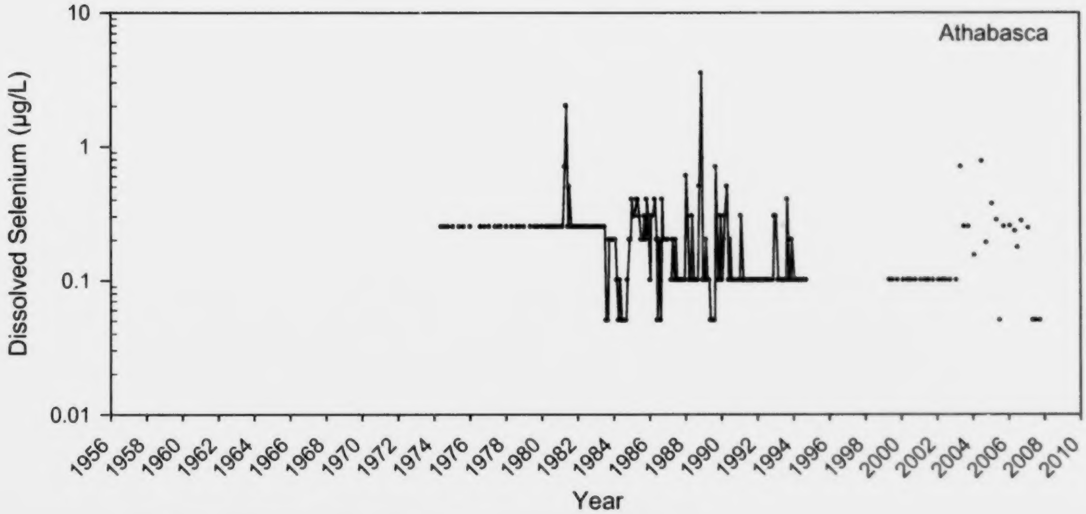


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.253		
Flow Adjusted								

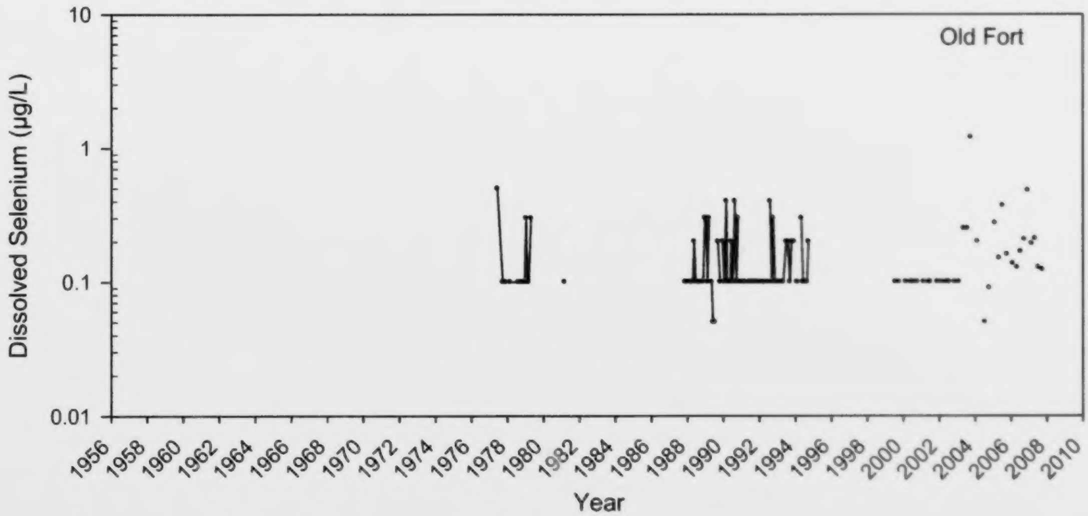


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.280		
Flow Adjusted								

Figure 217 Total selenium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

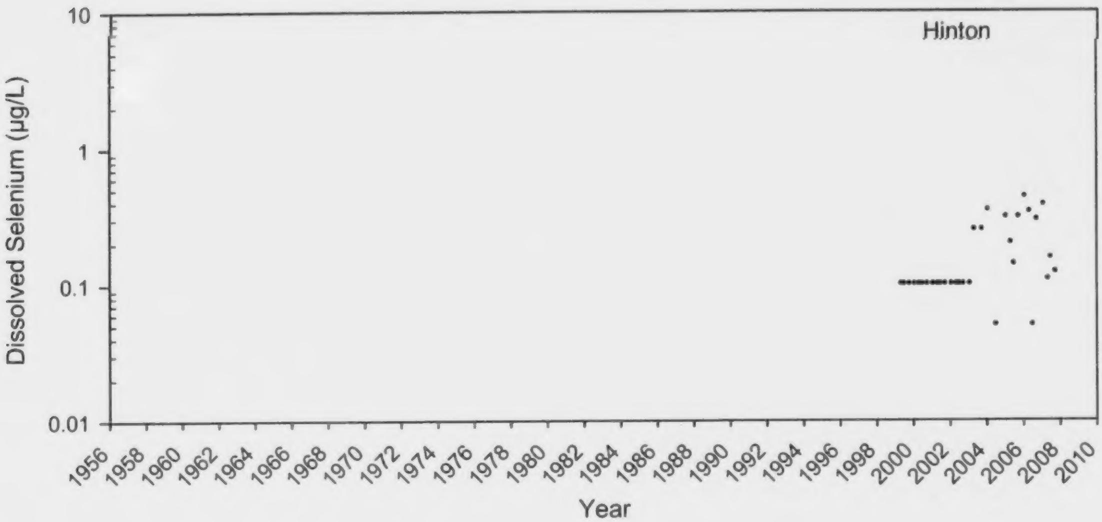


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.244		
Flow Adjusted								

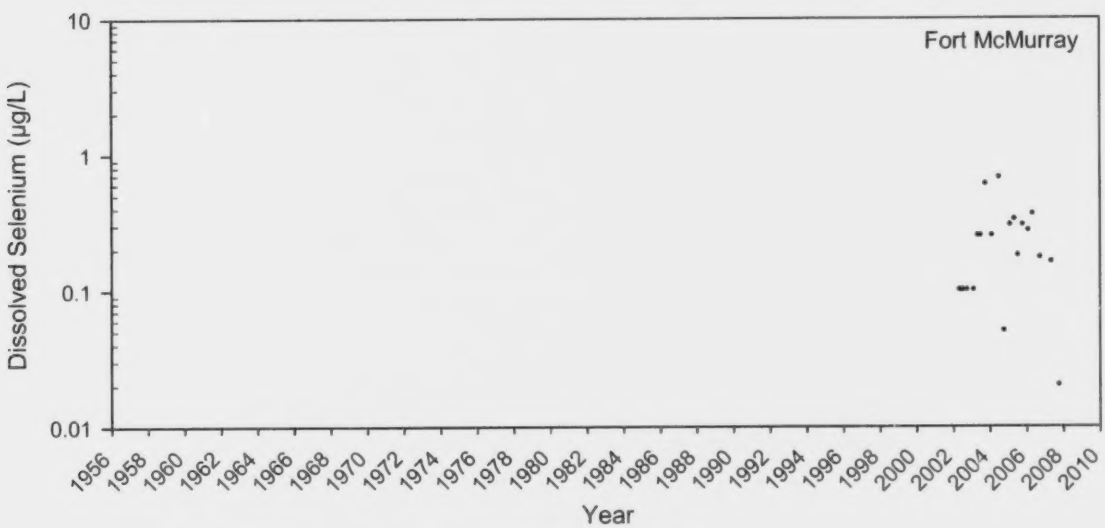


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.181		
Flow Adjusted								

Figure 218 Dissolved selenium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

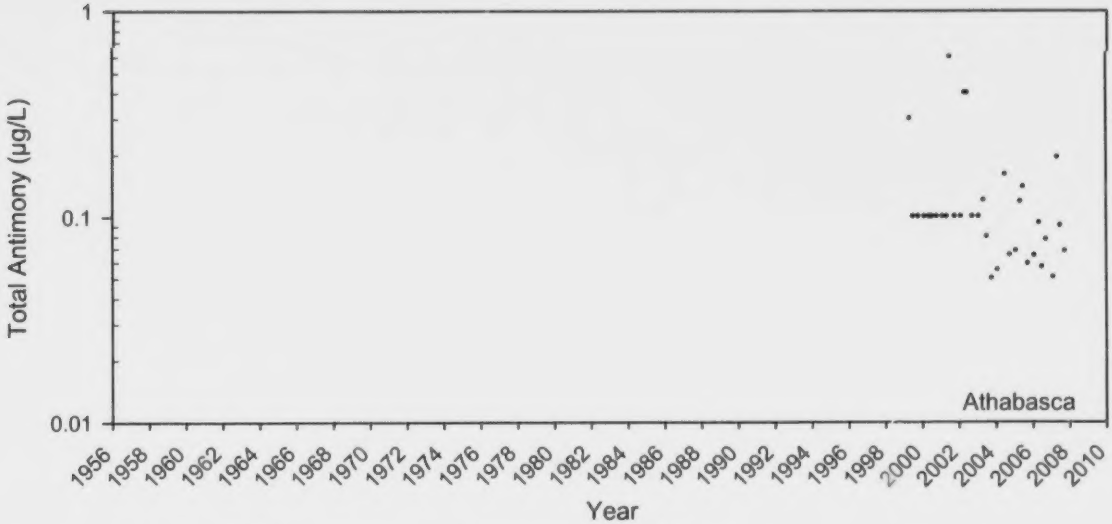


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.250		
Flow Adjusted								

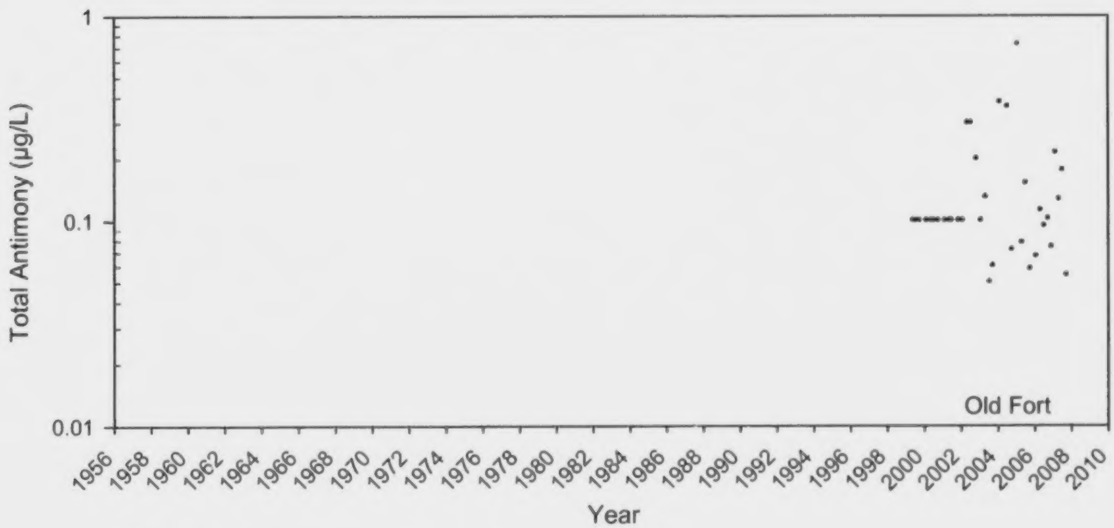


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.250		
Flow Adjusted								

Figure 219 Dissolved selenium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

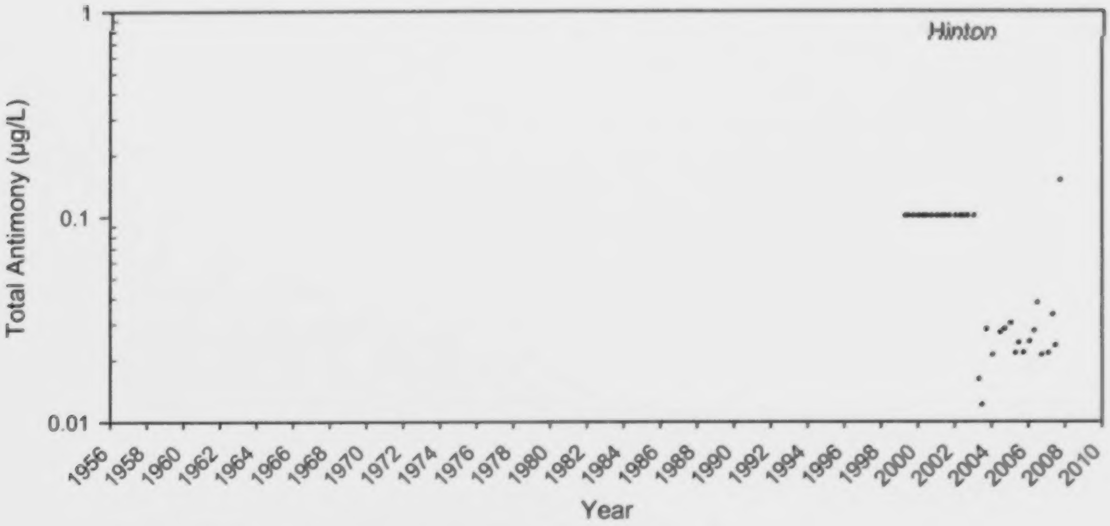


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.077		
Flow Adjusted								

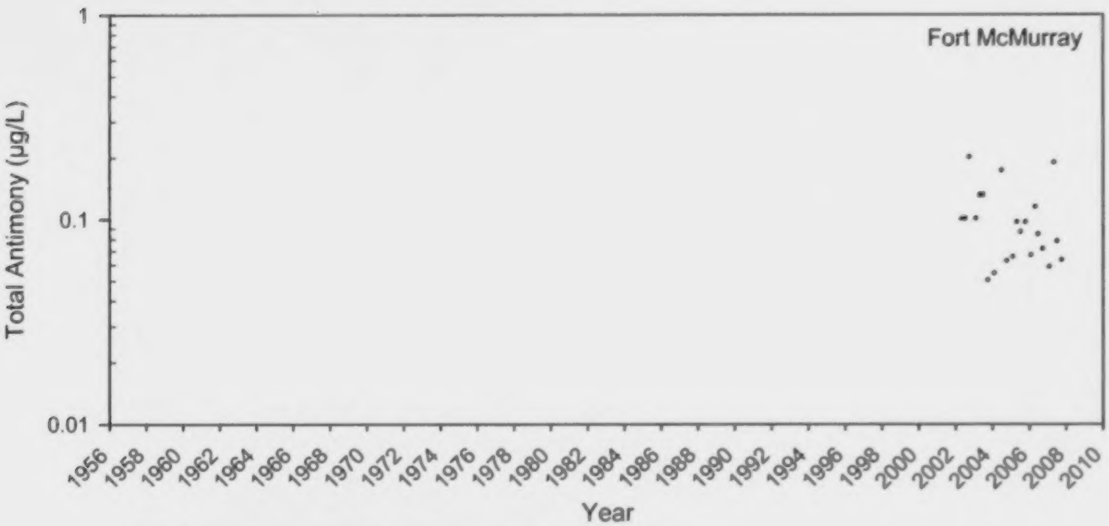


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.101		
Flow Adjusted								

Figure 220 Total antimony concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

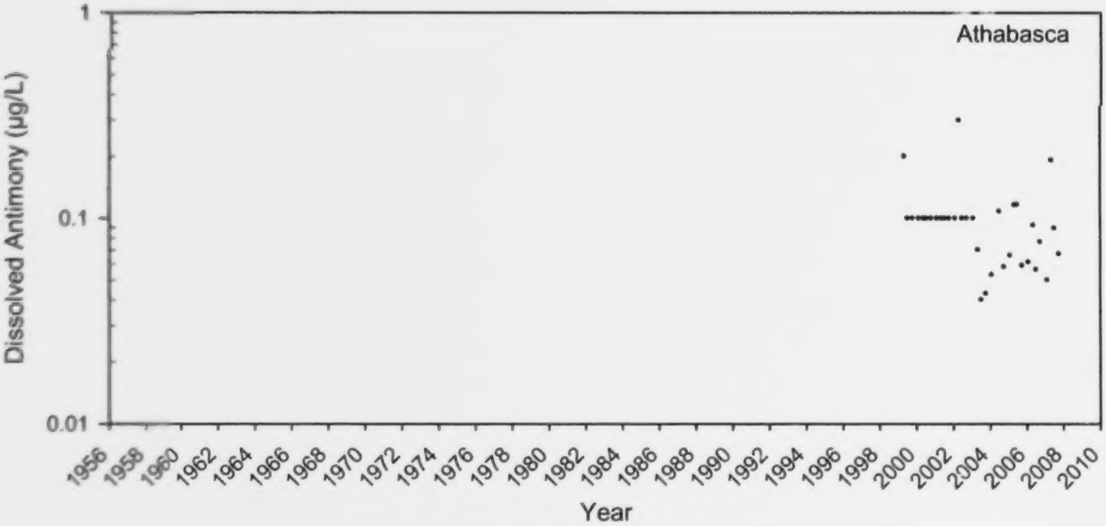


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0244		
Flow Adjusted								

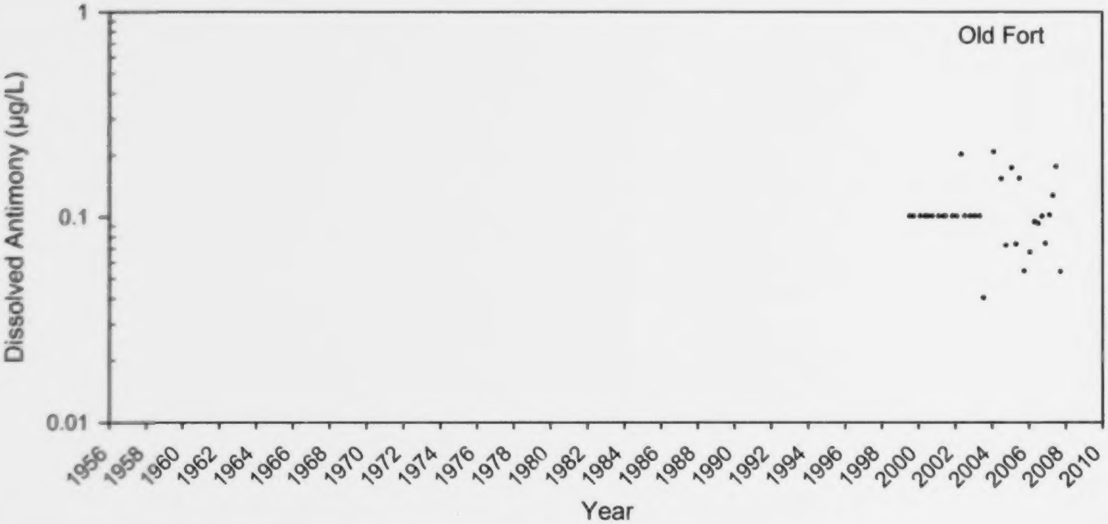


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0837		
Flow Adjusted								

Figure 221 Total antimony concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

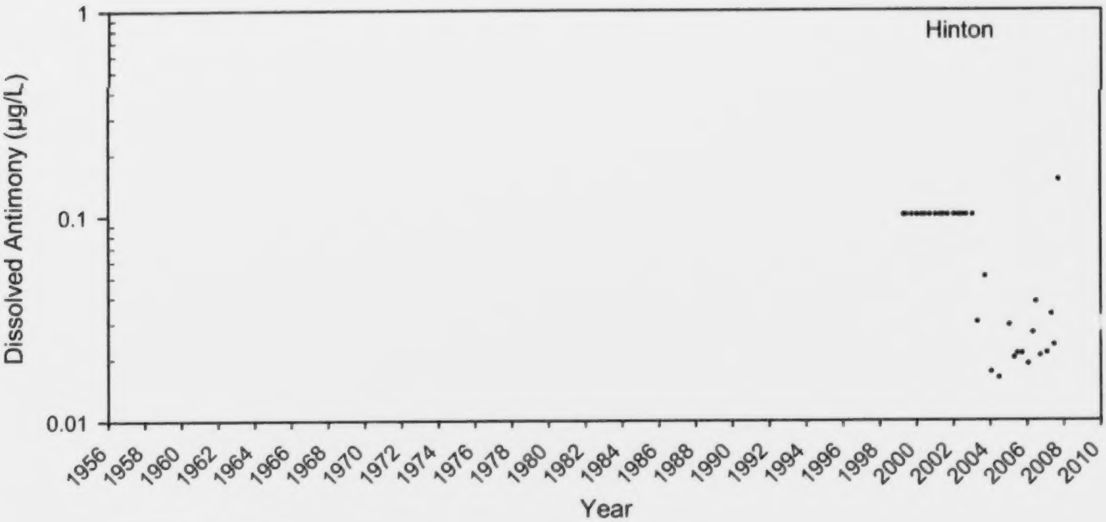


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0671		
Flow Adjusted								

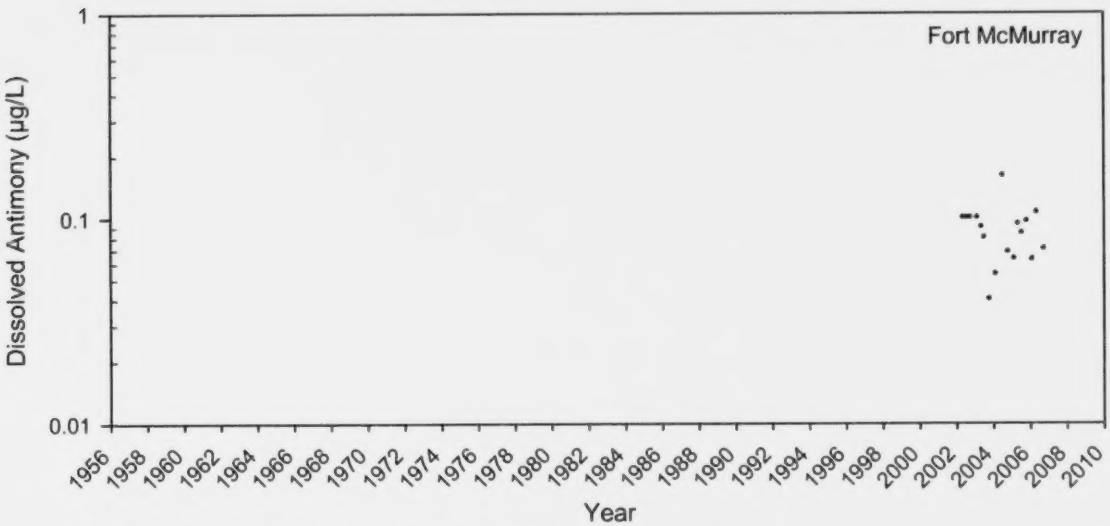


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0968		
Flow Adjusted								

Figure 222 Dissolved antimony concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

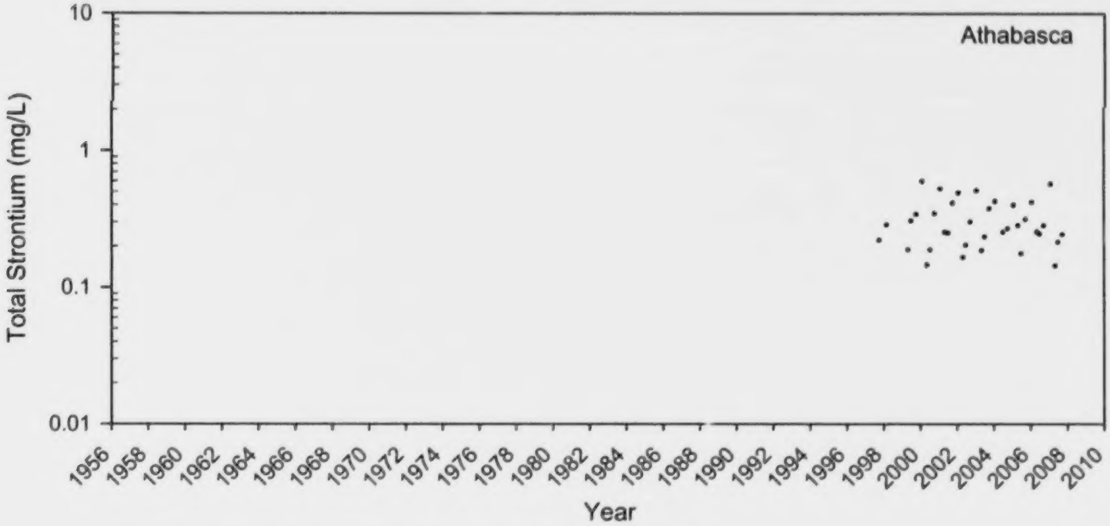


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0231		
Flow Adjusted								

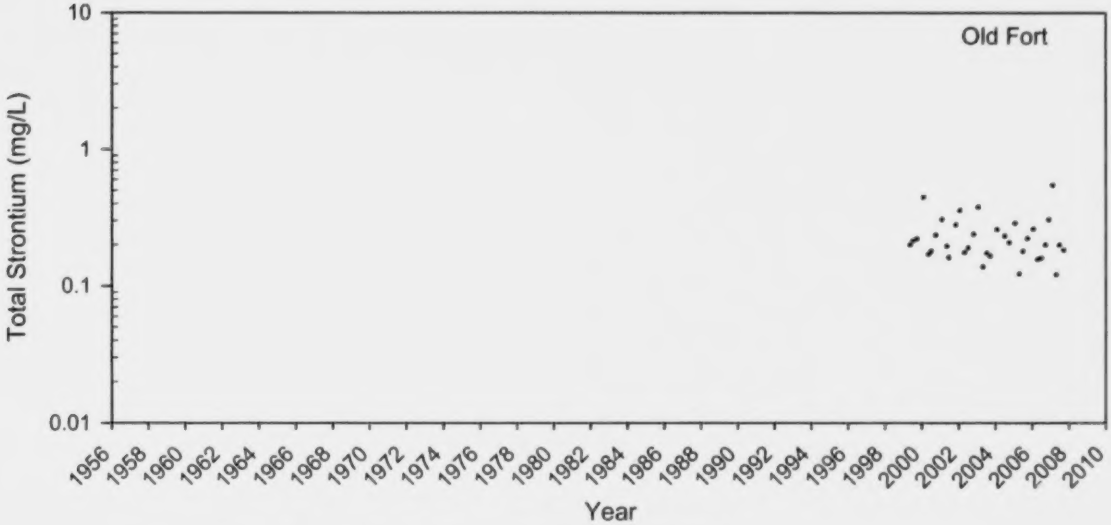


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0820		
Flow Adjusted								

Figure 223 Dissolved antimony concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

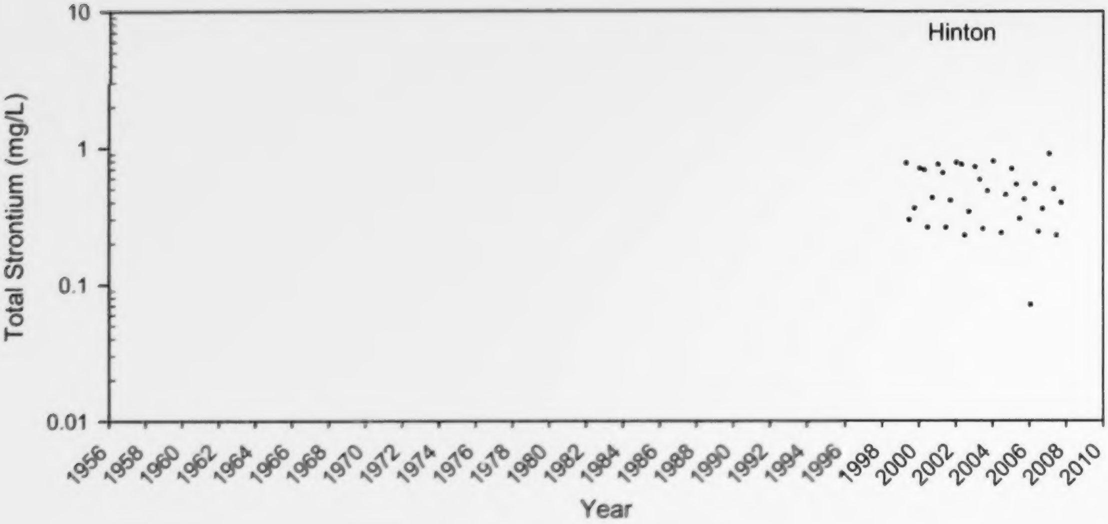


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.254		
Flow Adjusted								

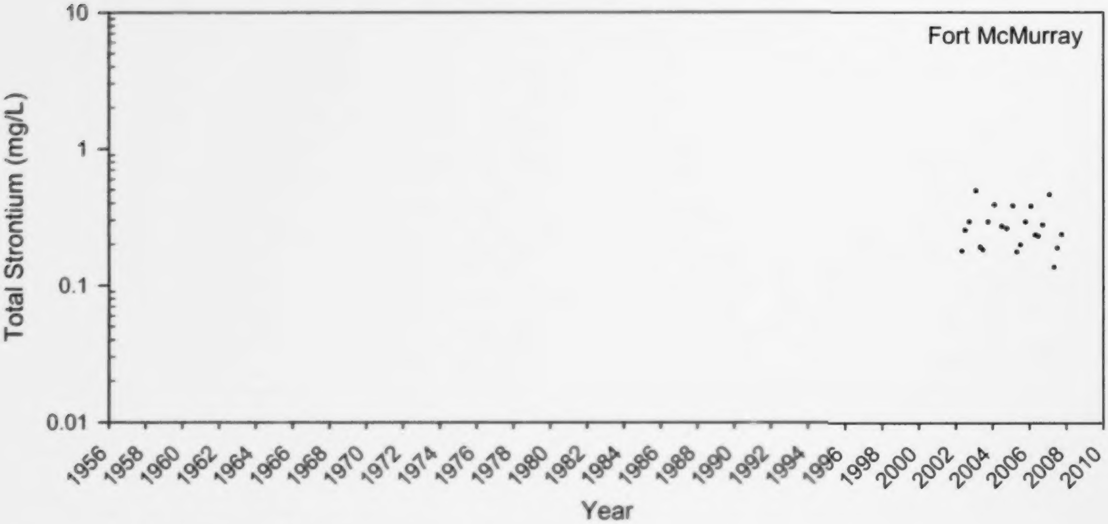


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.193		
Flow Adjusted								

Figure 224 Total strontium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

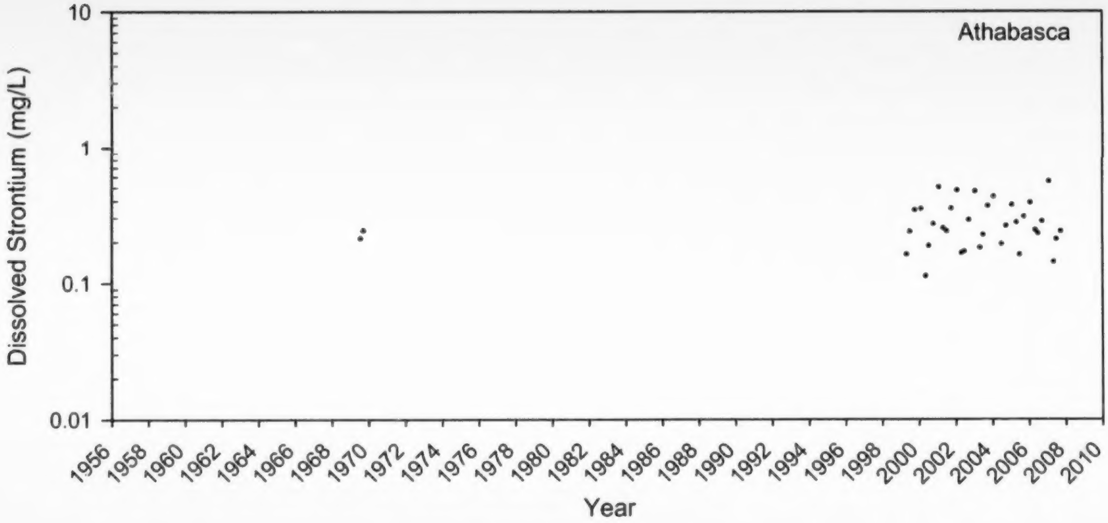


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.418		
Flow Adjusted								

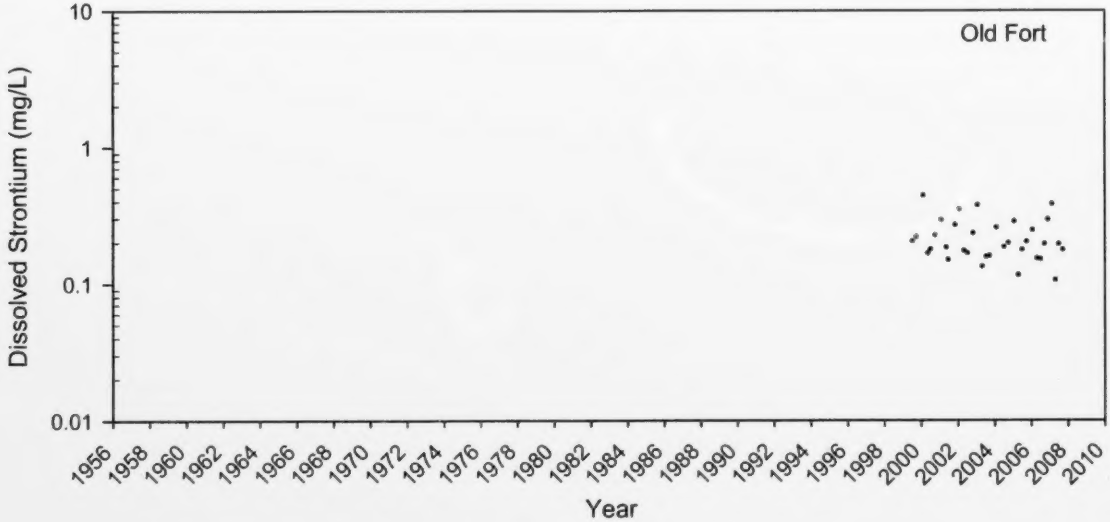


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.257		
Flow Adjusted								

Figure 225 Total strontium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

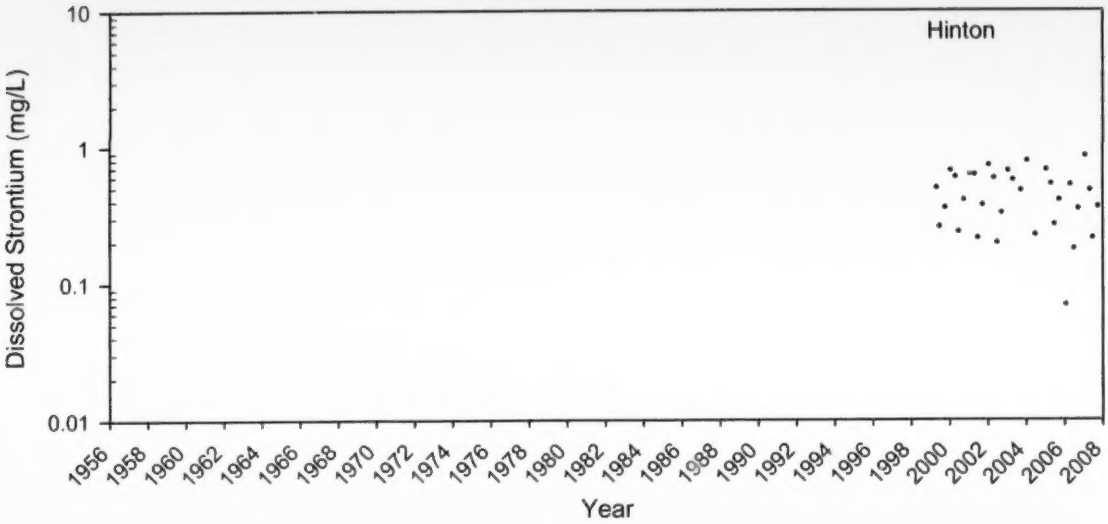


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.254		
Flow Adjusted								

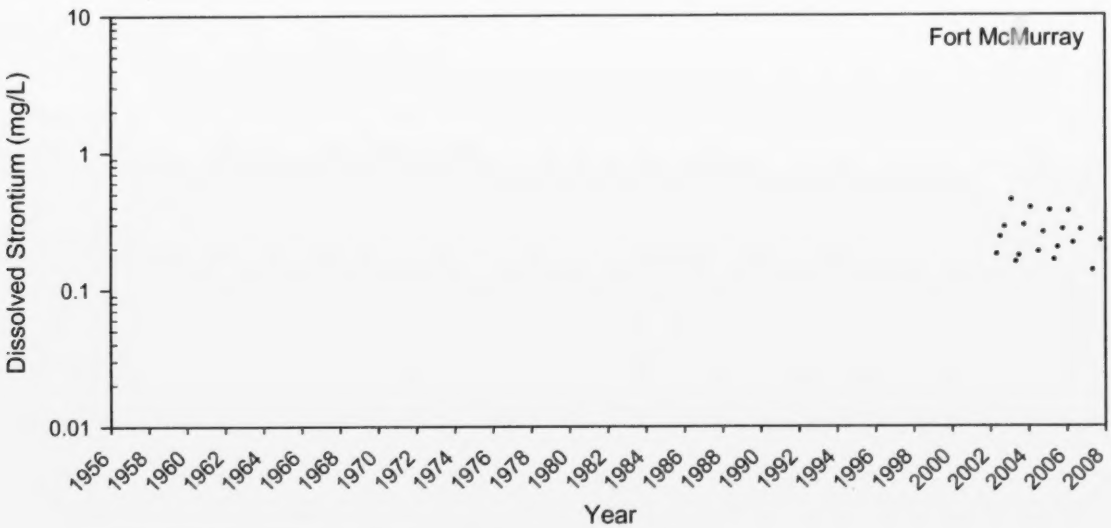


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.193		
Flow Adjusted								

Figure 226 Dissolved strontium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

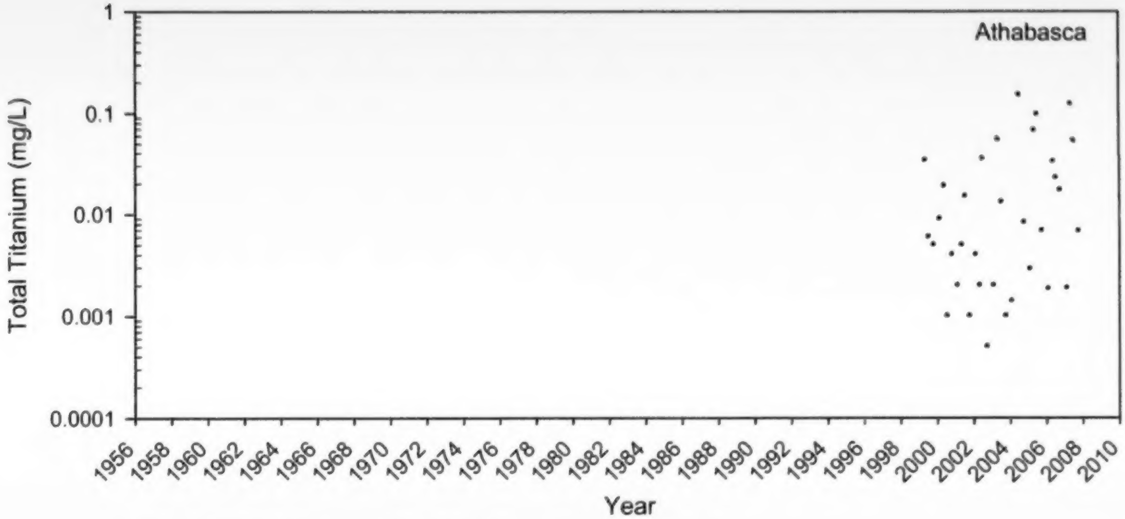


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.401		
Flow Adjusted								

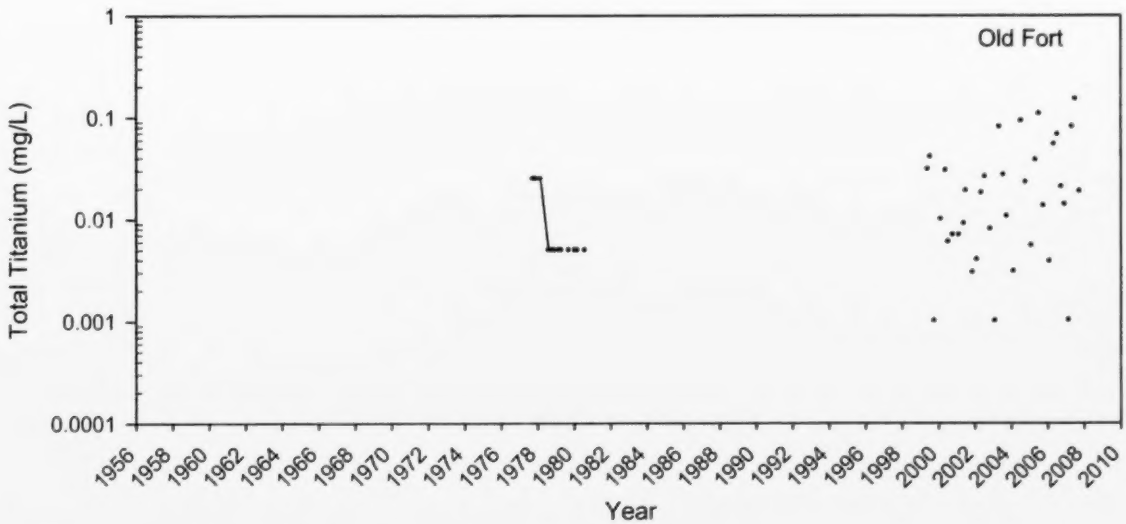


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.237		
Flow Adjusted								

Figure 227 Dissolved strontium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

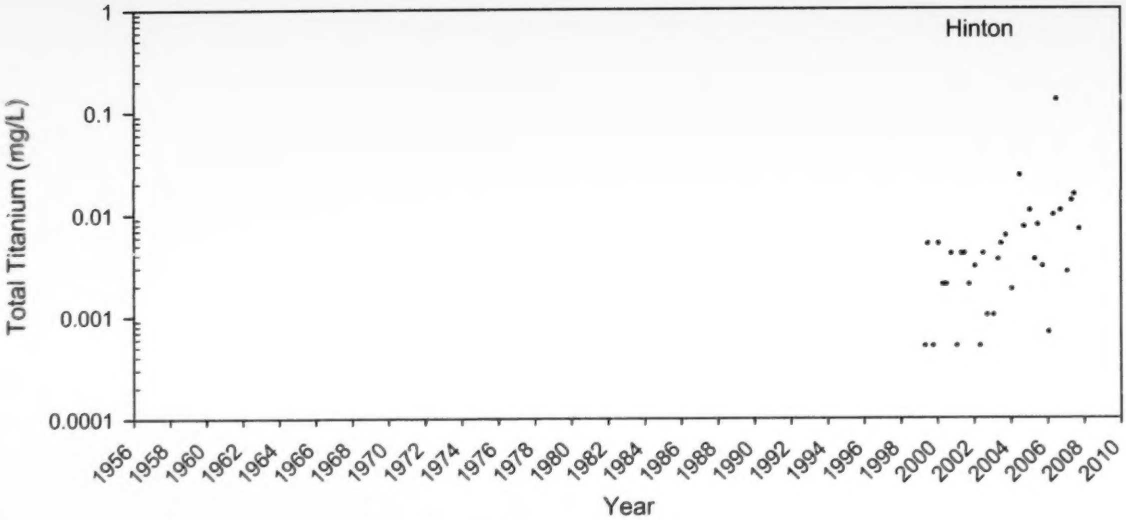


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0069		
Flow Adjusted								

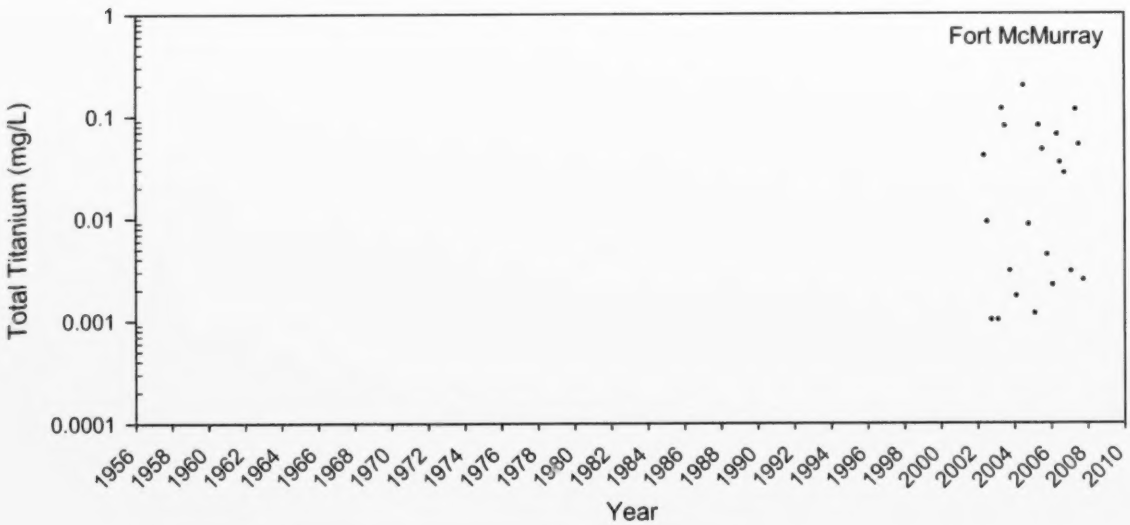


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0160		
Flow Adjusted								

Figure 228 Total titanium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

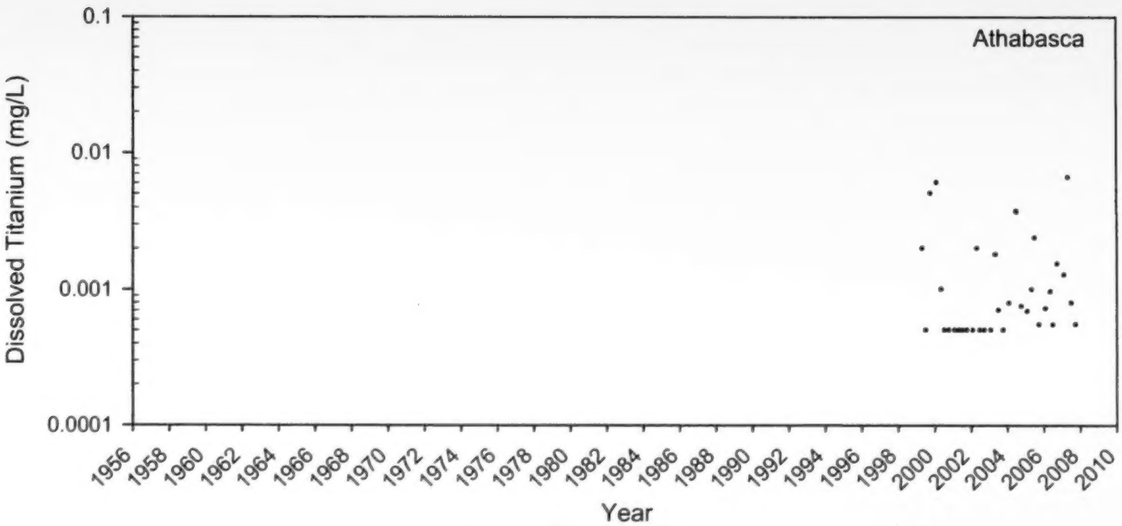


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0040		
Flow Adjusted								

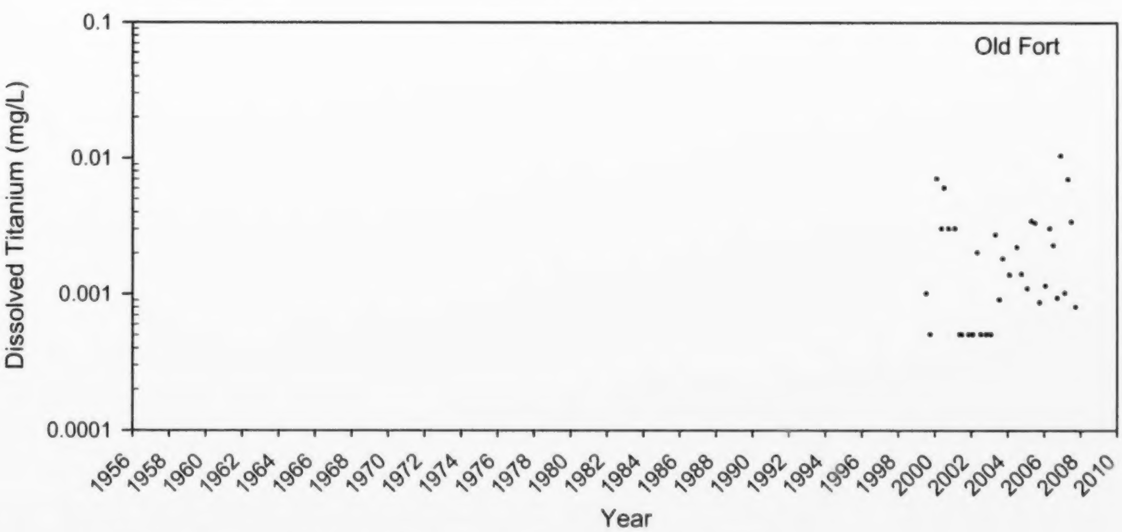


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0181		
Flow Adjusted								

Figure 229 Total titanium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

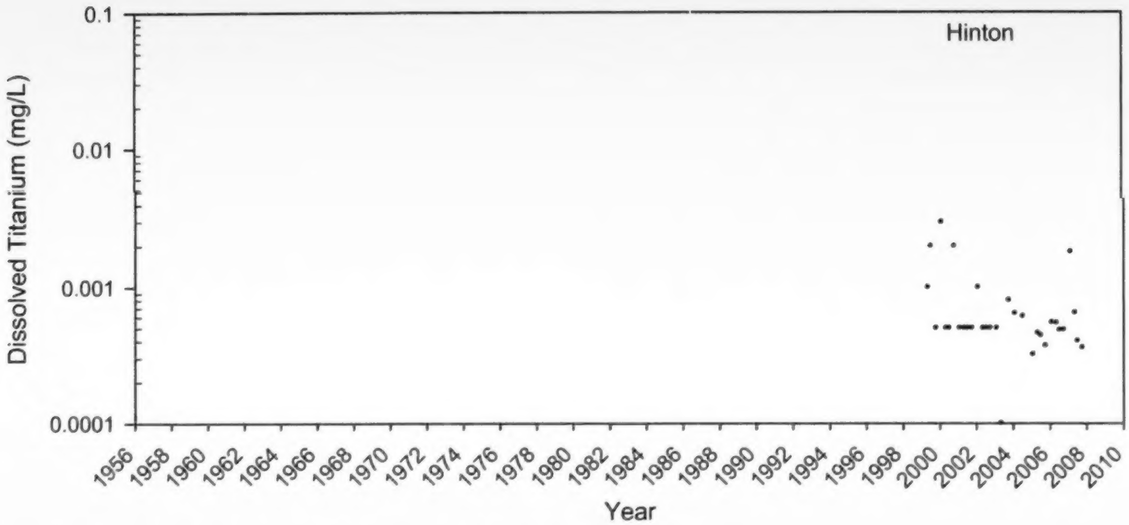


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00071		
Flow Adjusted								

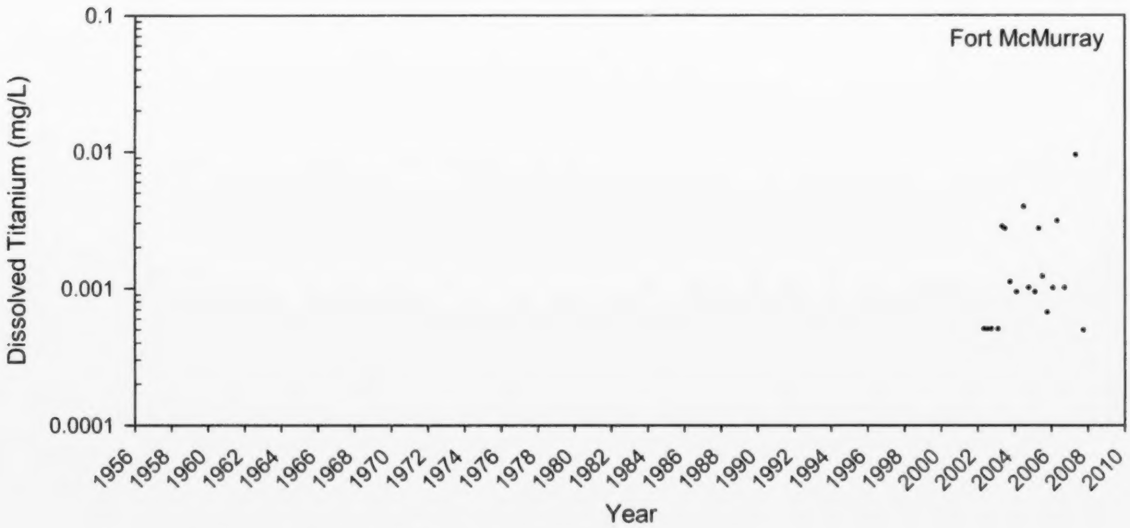


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00138		
Flow Adjusted								

Figure 230 Dissolved titanium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

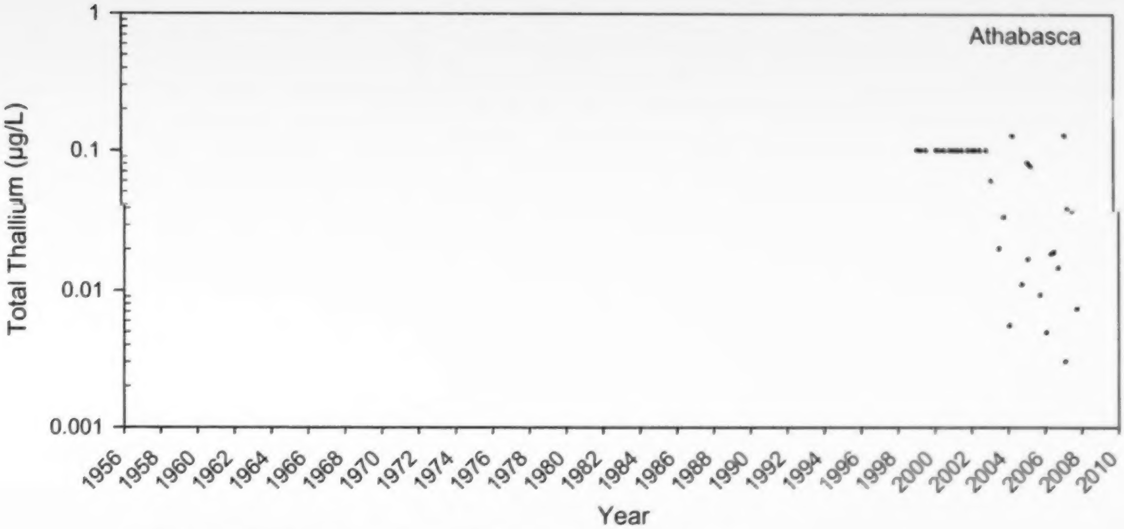


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0005		
Flow Adjusted								

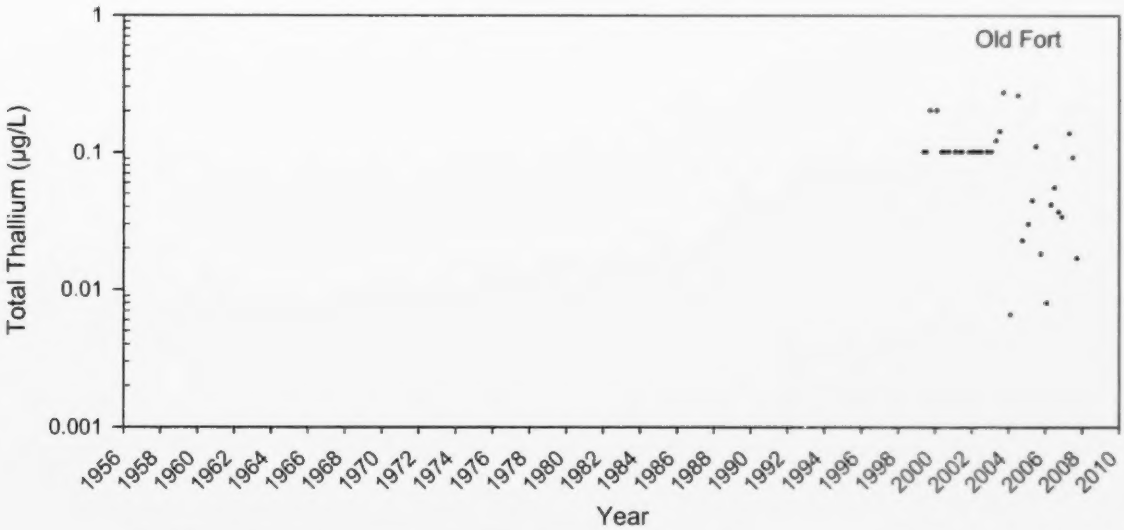


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0010		
Flow Adjusted								

Figure 231 Dissolved titanium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

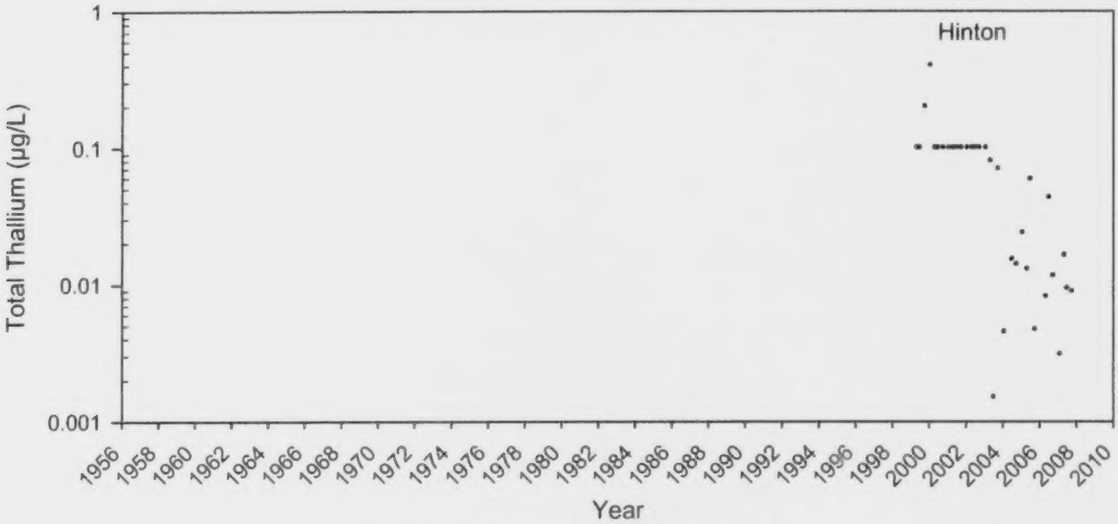


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0189		
Flow Adjusted								

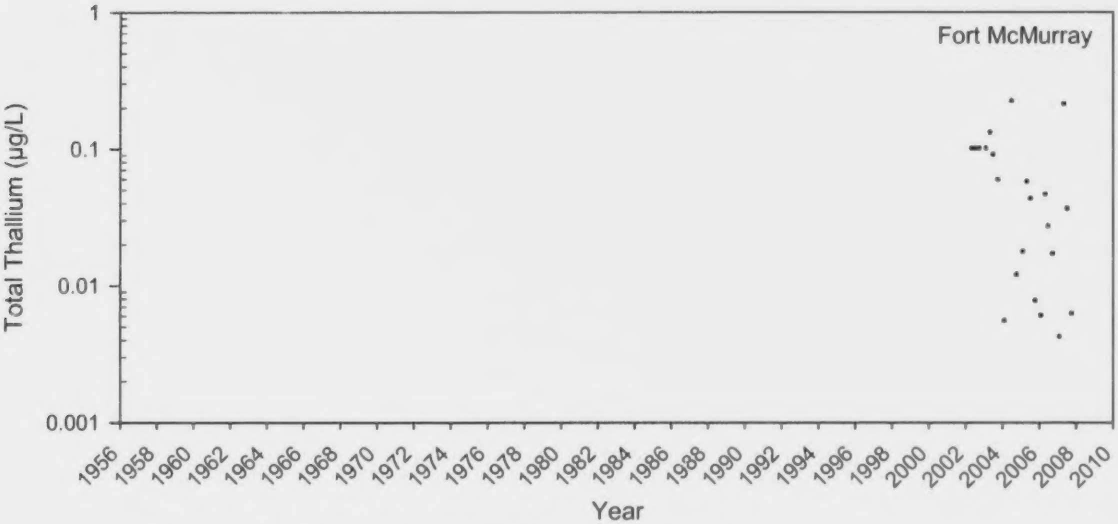


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0425		
Flow Adjusted								

Figure 232 Total thallium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

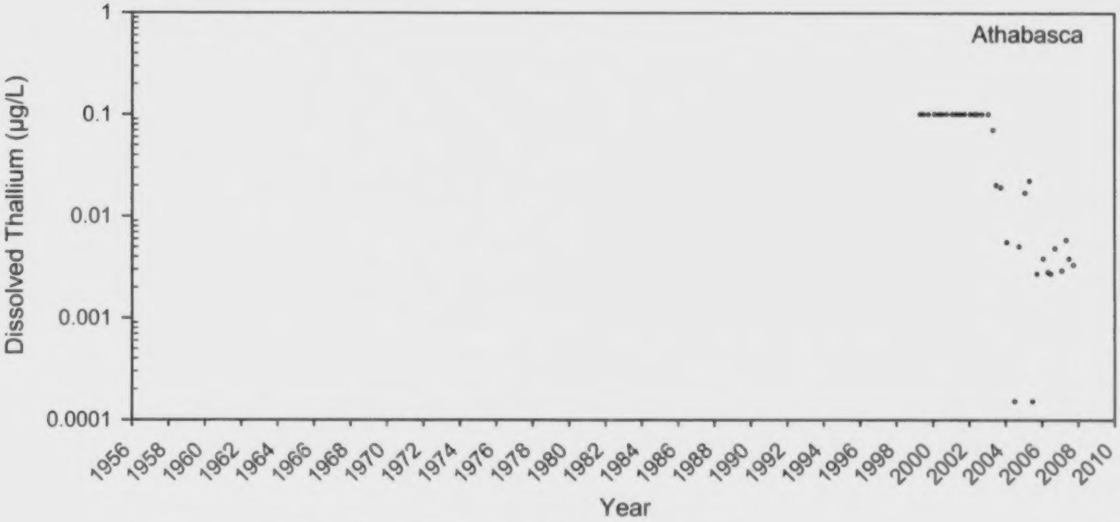


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0130		
Flow Adjusted								

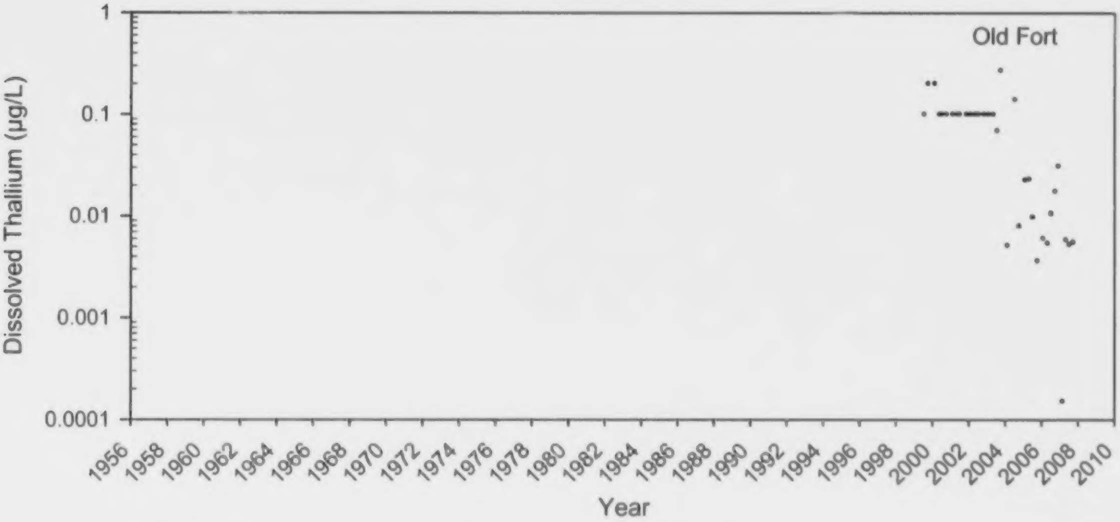


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0362		
Flow Adjusted								

Figure 233 Total thallium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

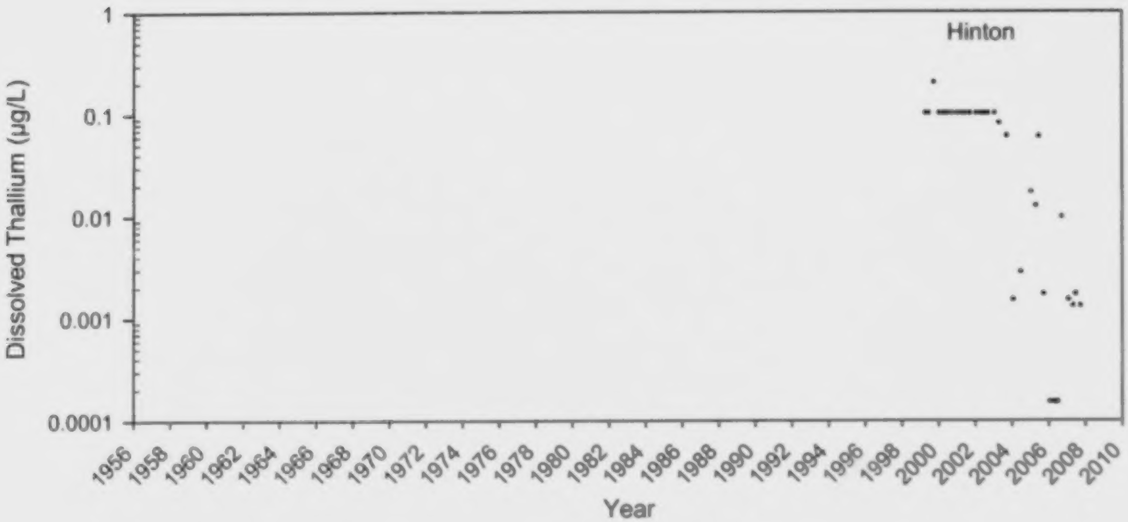


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0048		
Flow Adjusted								

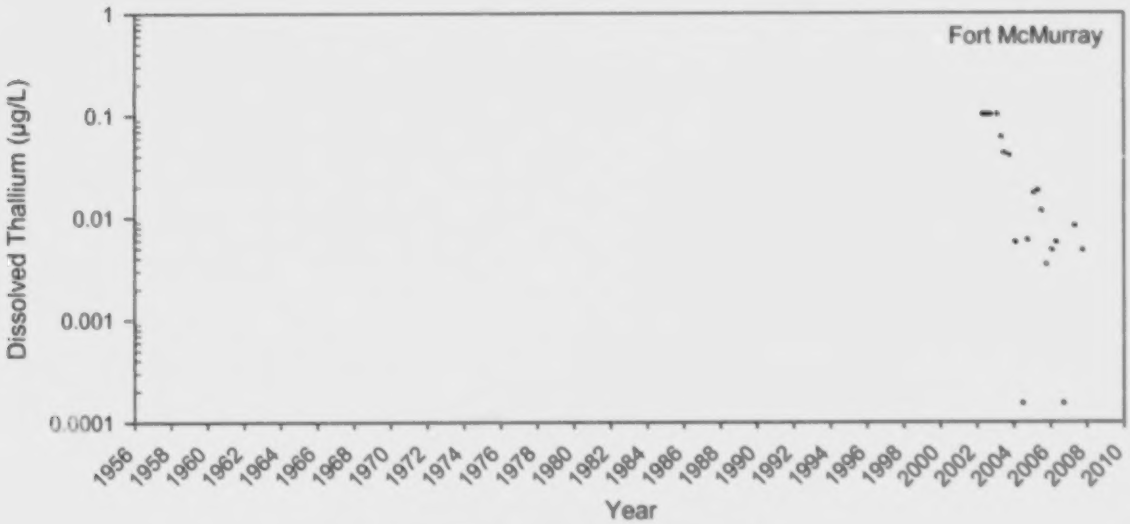


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0101		
Flow Adjusted								

Figure 234 Dissolved thallium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

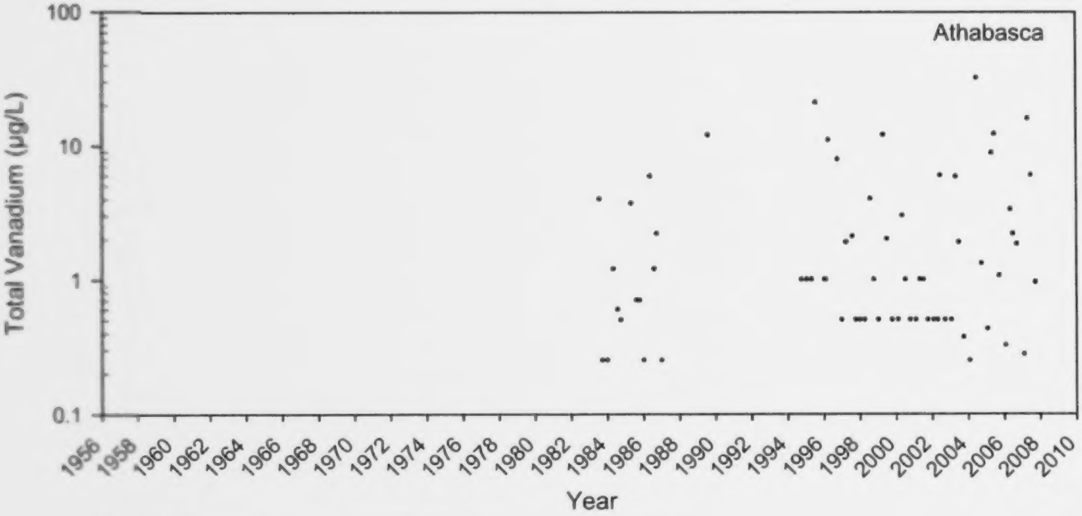


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0017		
Flow Adjusted								

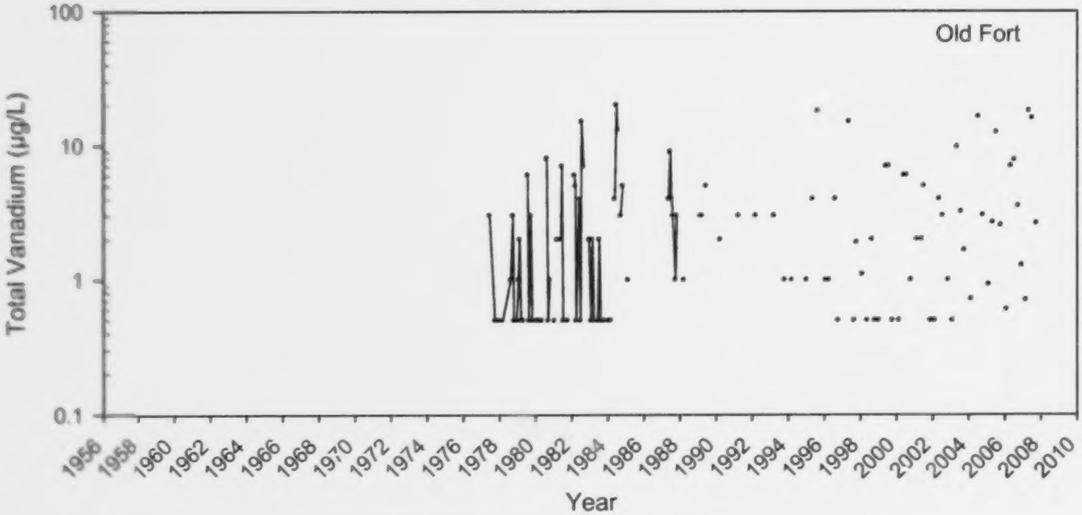


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0070		
Flow Adjusted								

Figure 235 Dissolved thallium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

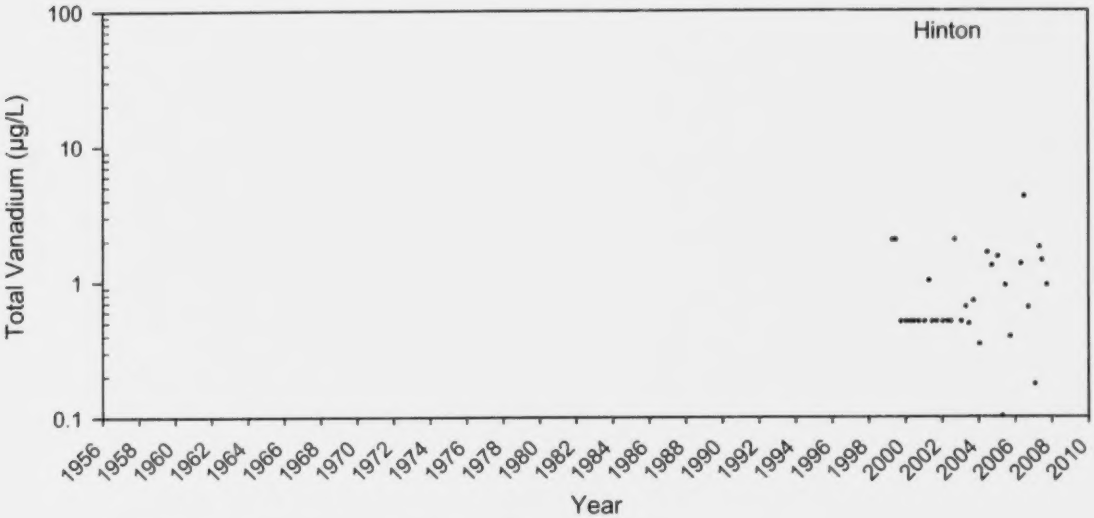


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						1.00		
Flow Adjusted								

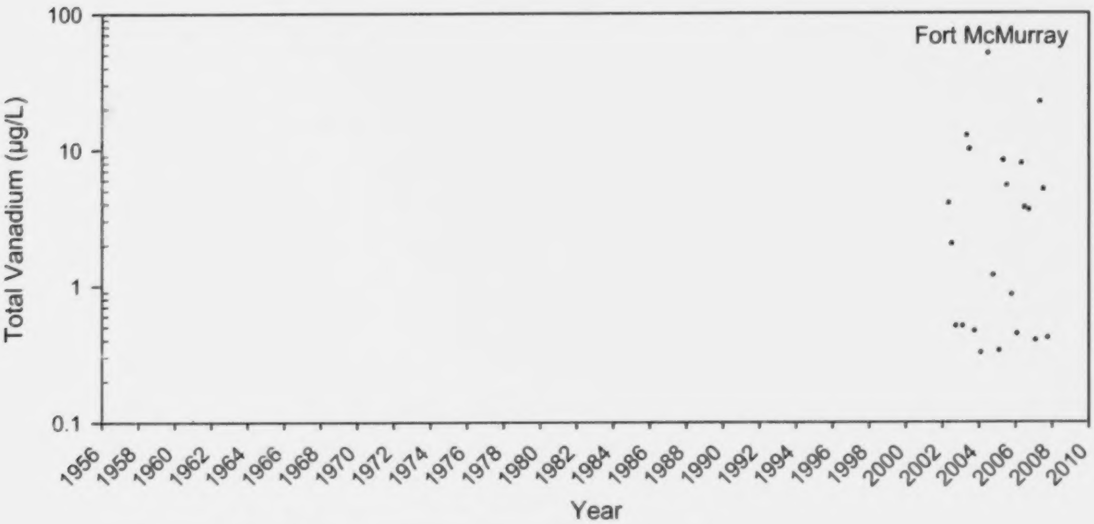


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						2.00		
Flow Adjusted								

Figure 236 Total vanadium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

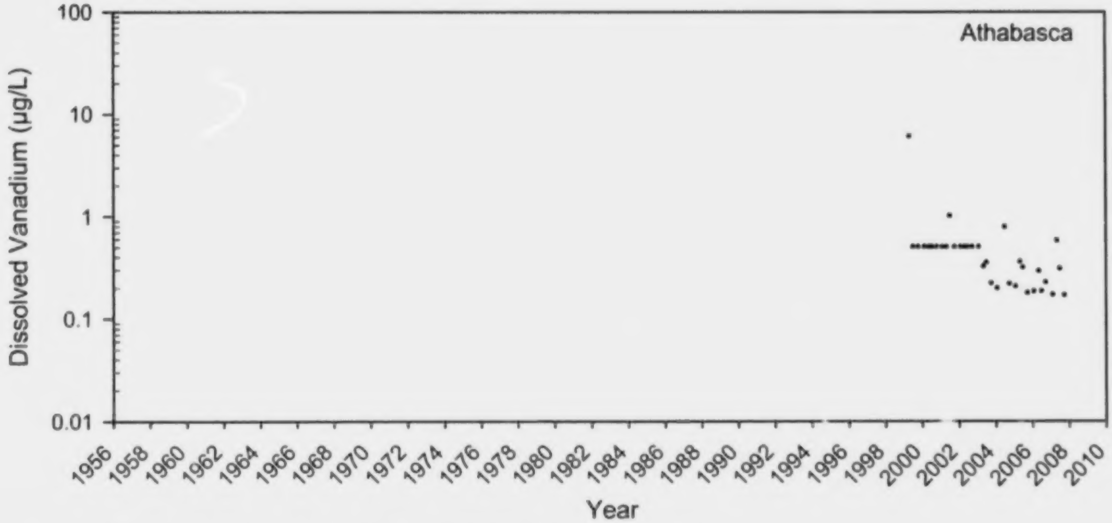


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.50		
Flow Adjusted								

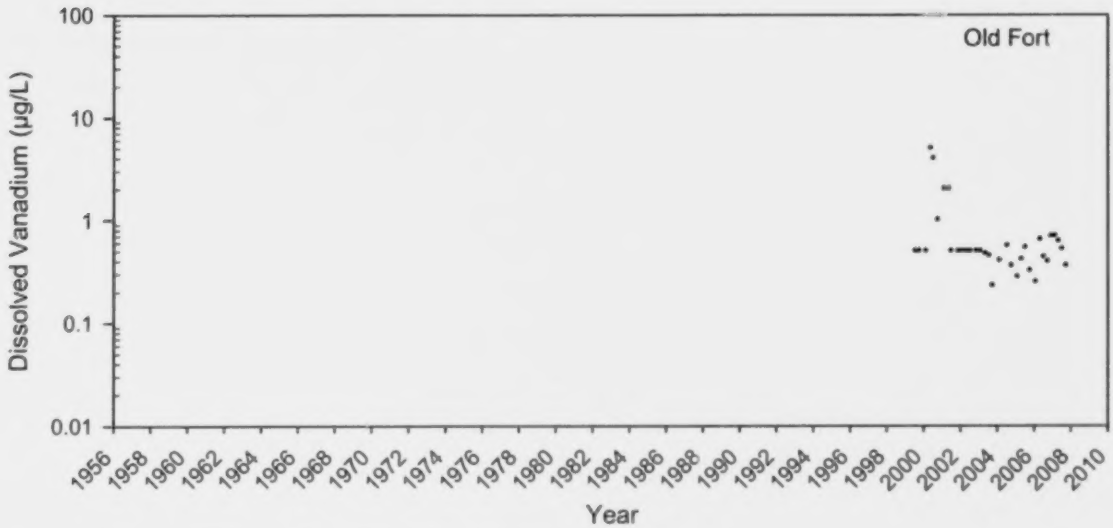


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						2.78		
Flow Adjusted								

Figure 237 Total vanadium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

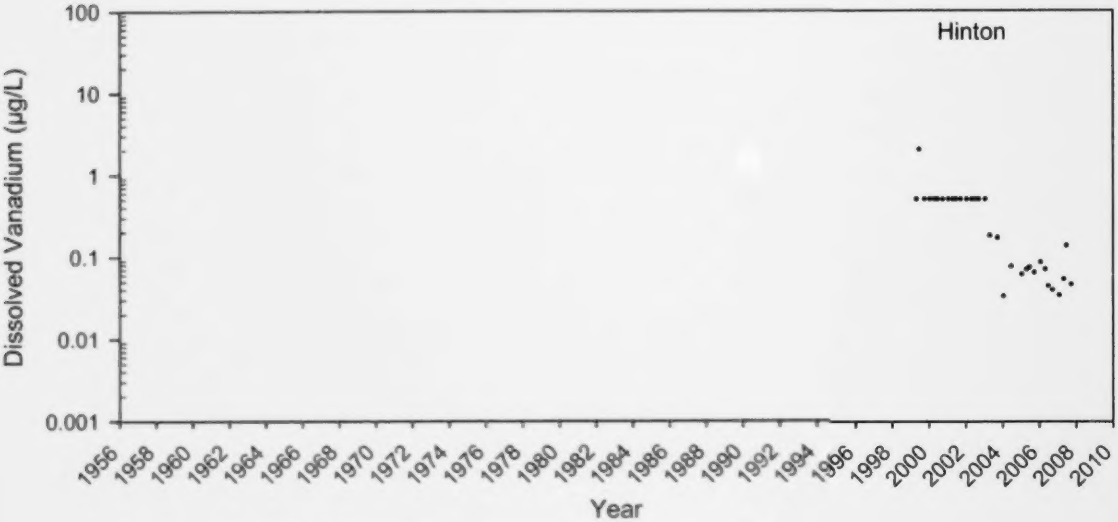


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.224		
Flow Adjusted								

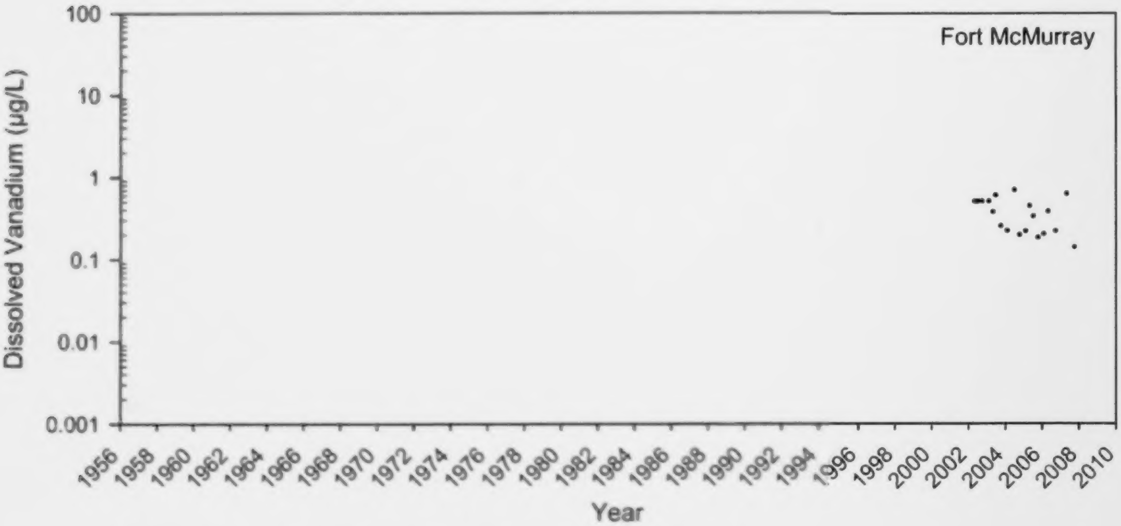


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.443		
Flow Adjusted								

Figure 238 Dissolved vanadium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.



Overall Trend		1987 Step Trend	Pre-1987Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.070		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.289		
Flow Adjusted								

Figure 239 Dissolved vanadium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

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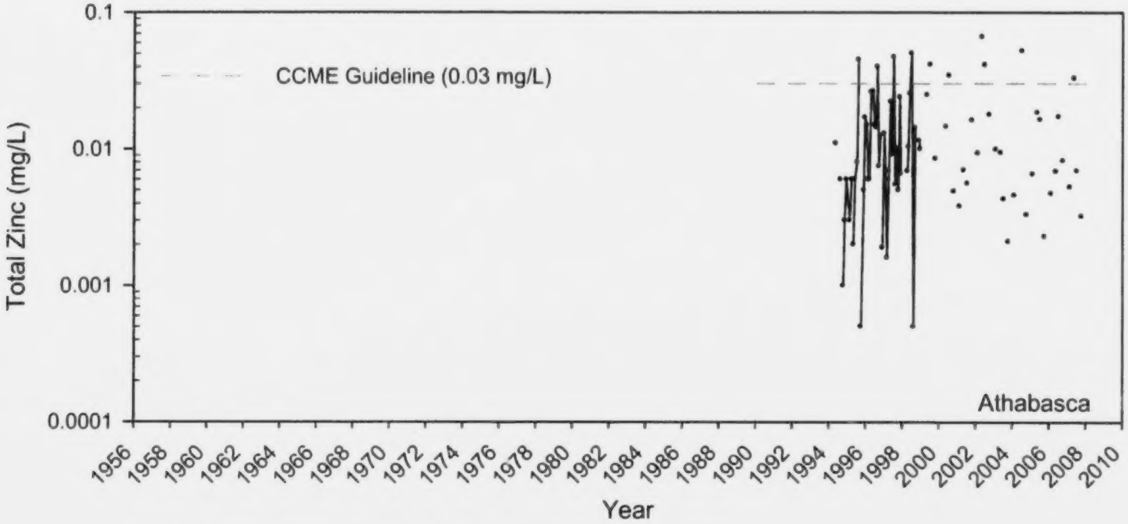
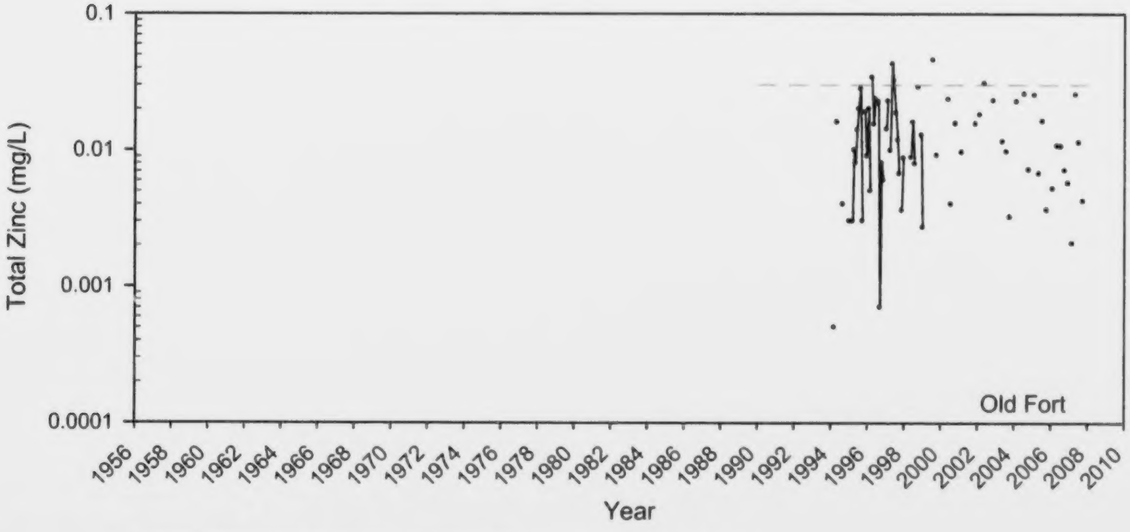


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0082	-0.00004	none
Flow Adjusted								
							-0.00038	none



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0107	-0.00026	none
Flow Adjusted								
							-0.00016	none

Figure 240 Total zinc concentration in the Athabasca River at Athabasca and Old Fort. Significance of monotonic trends was determined at a 95% confidence interval (i.e., p<0.05).

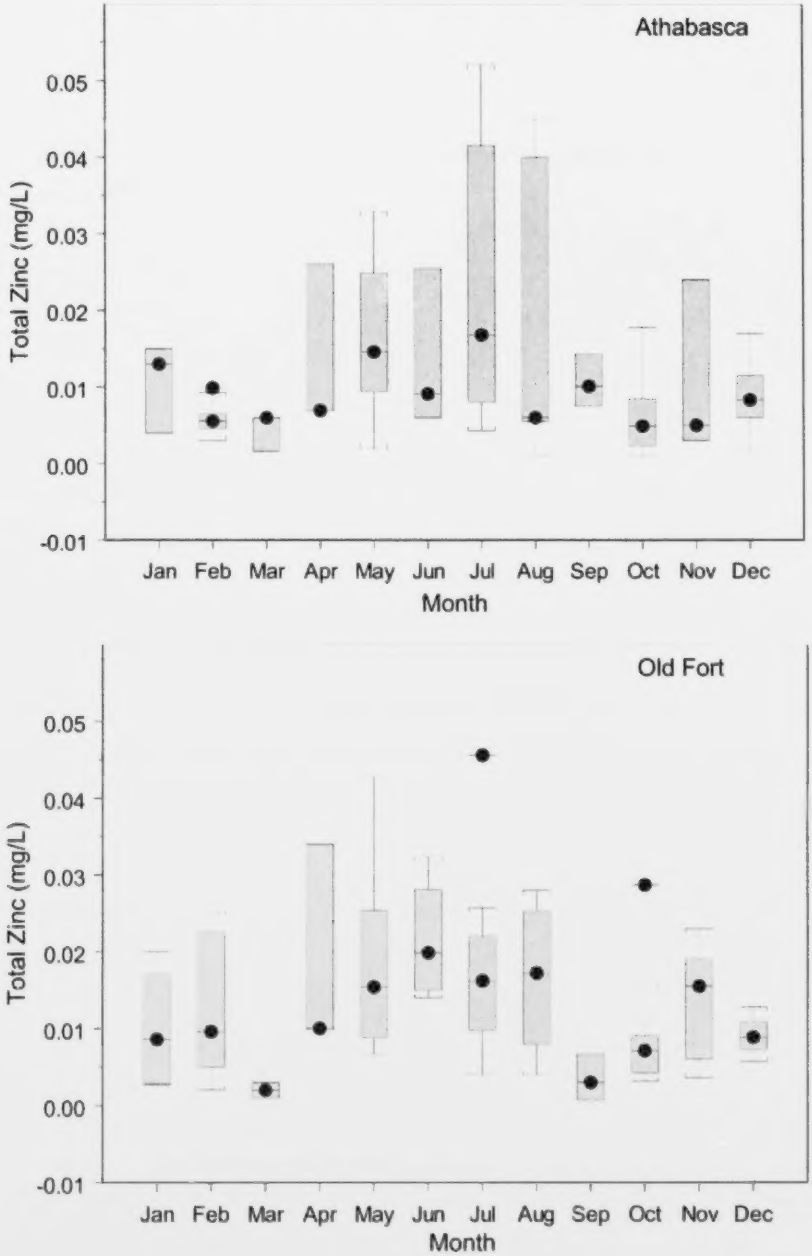
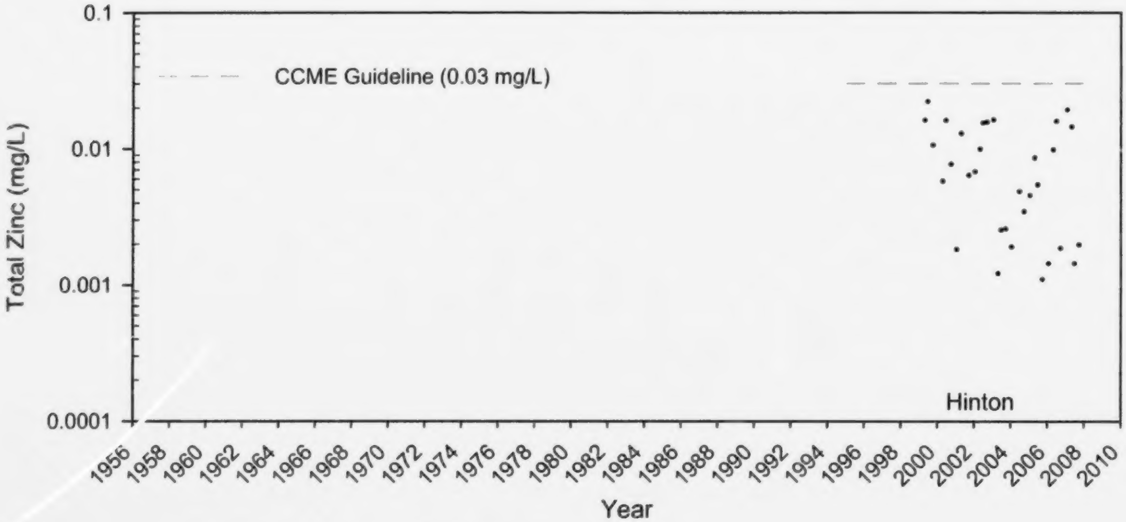
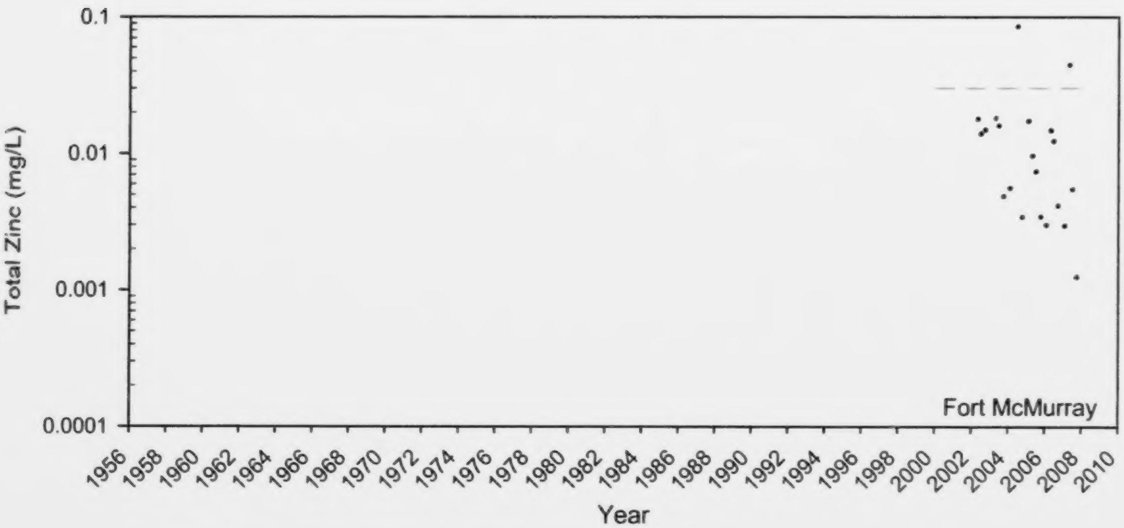


Figure 241 Seasonality of total zinc in the Athabasca River at Athabasca and Old Fort. Some outliers may exceed axis range.

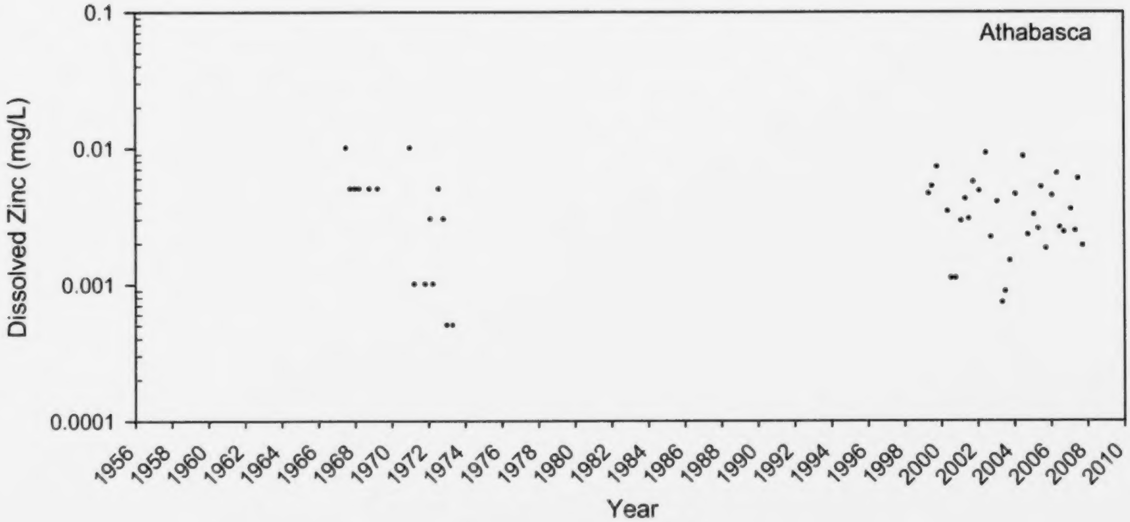


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0063		
Flow Adjusted								

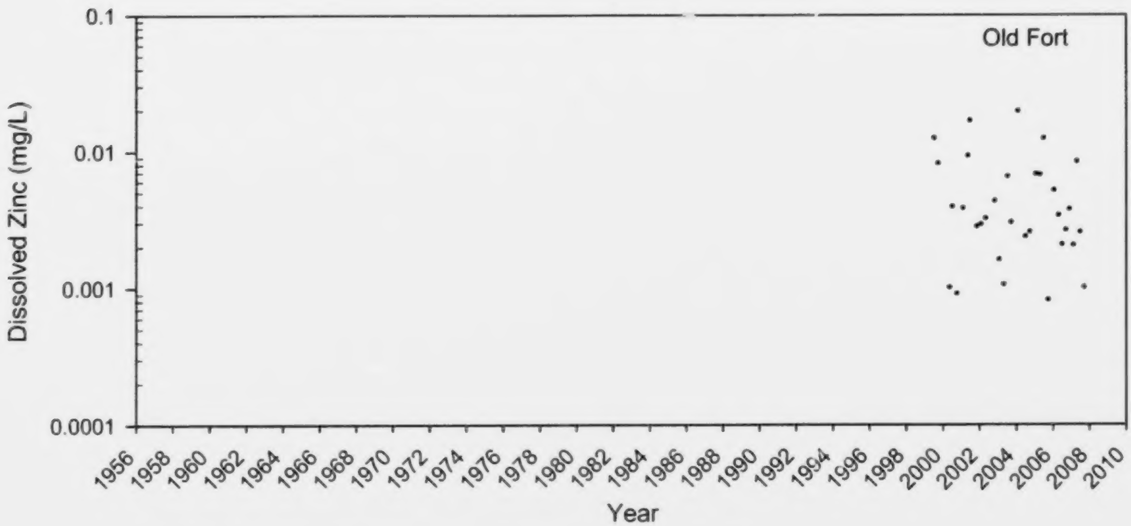


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0095		
Flow Adjusted								

Figure 242 Total zinc concentration in the Athabasca river at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

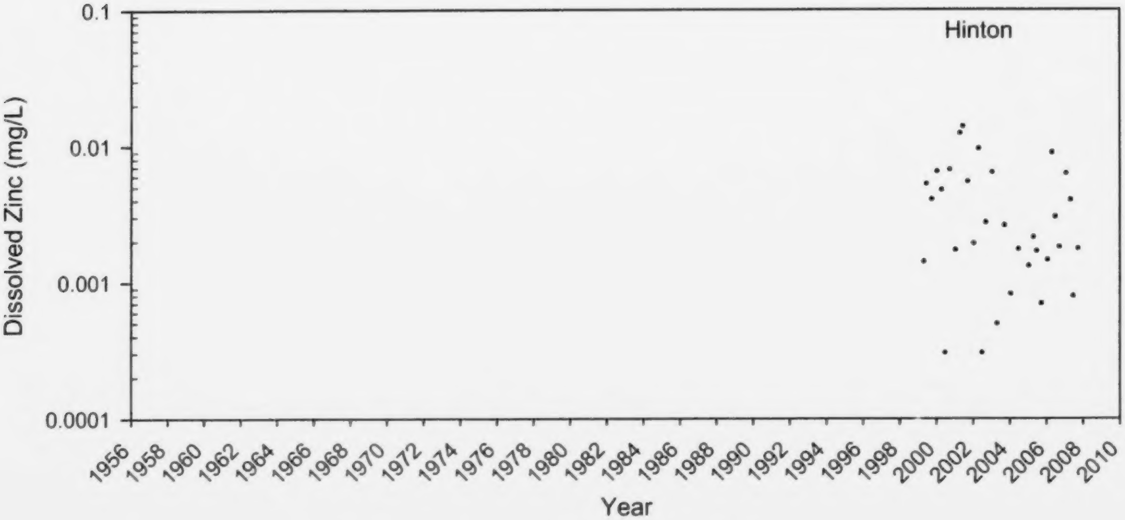


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0033		
Flow Adjusted								

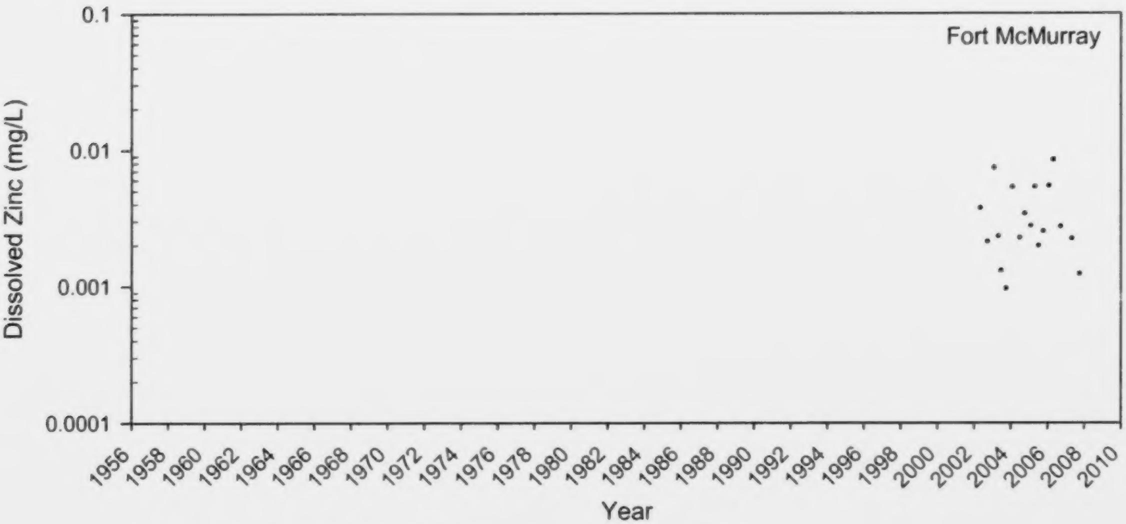


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0033		

Figure 243 Dissolved zinc concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

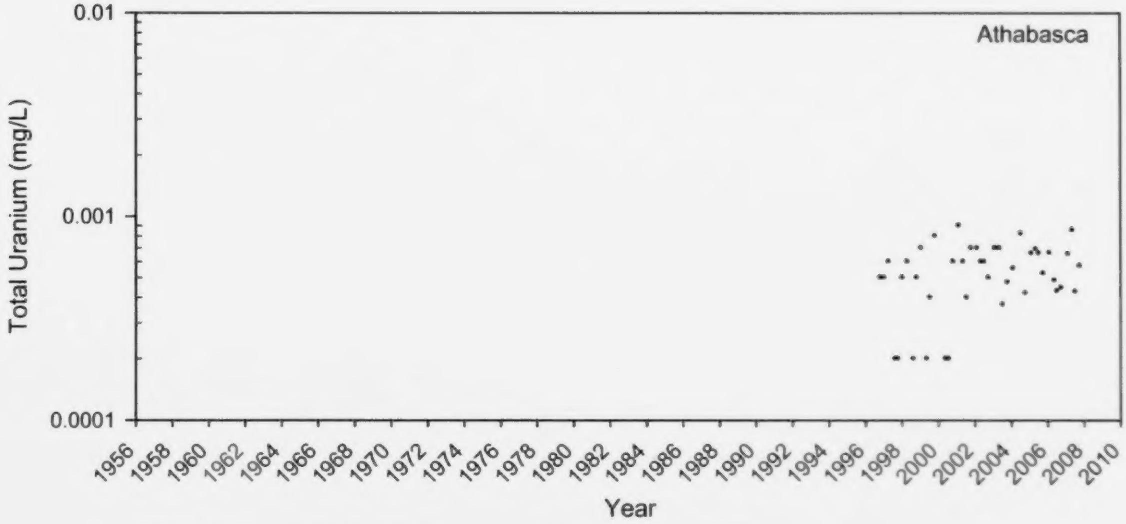


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0026		
Flow Adjusted								

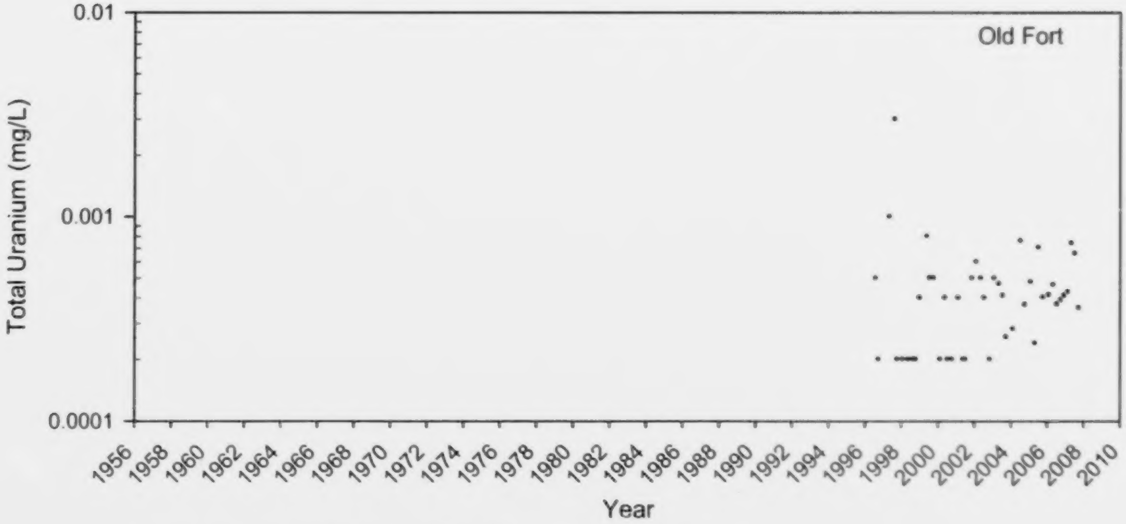


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.0026		
Flow Adjusted								

Figure 244 Dissolved zinc concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

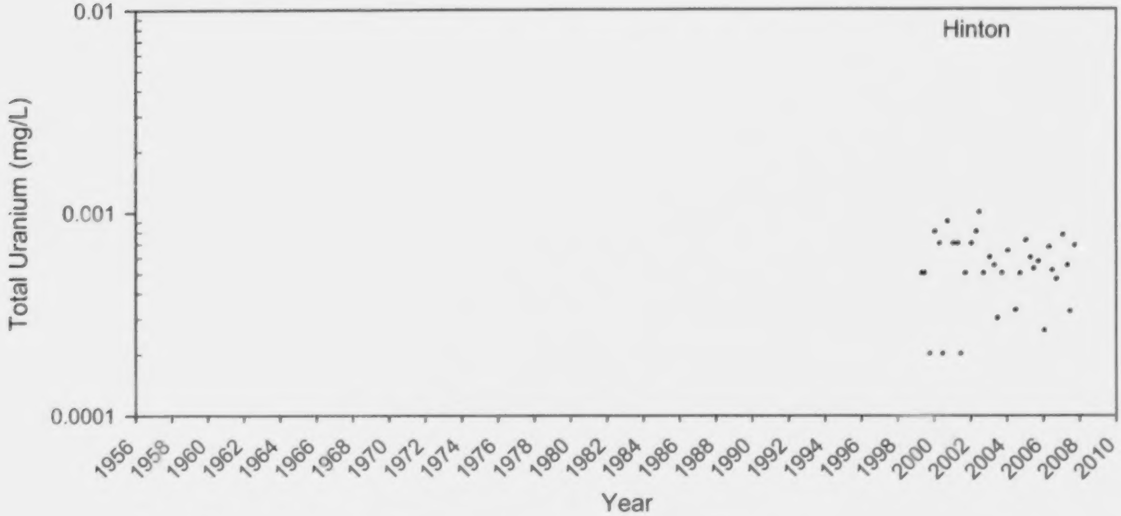


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00056		
Flow Adjusted								

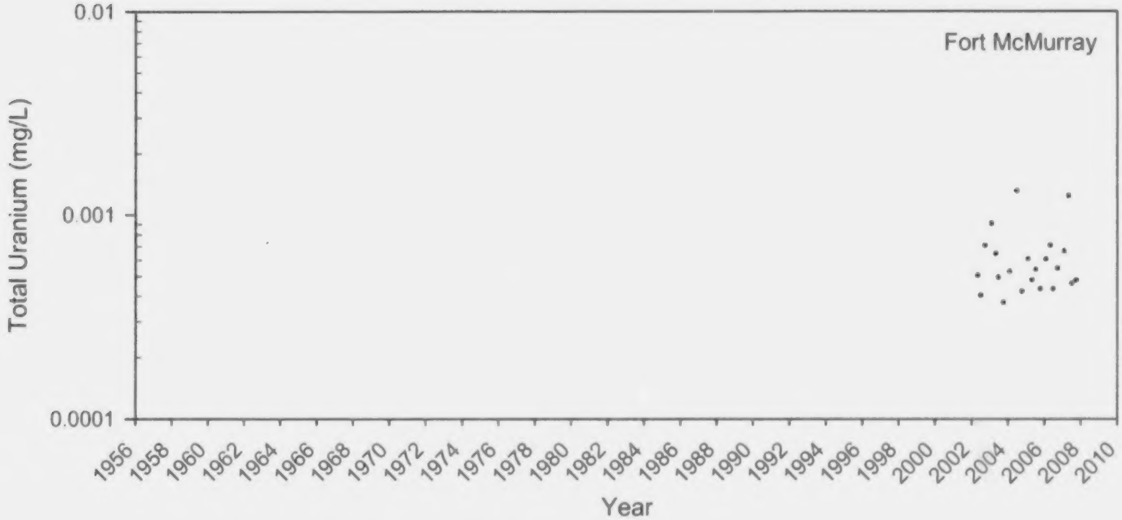


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00040		
Flow Adjusted								

Figure 245 Total uranium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

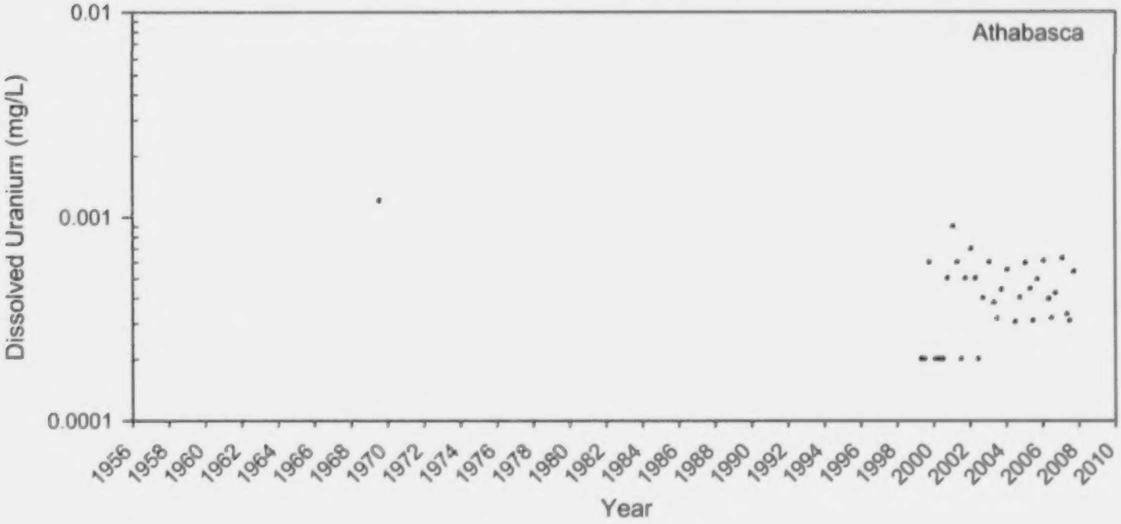


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00055		
Flow Adjusted								

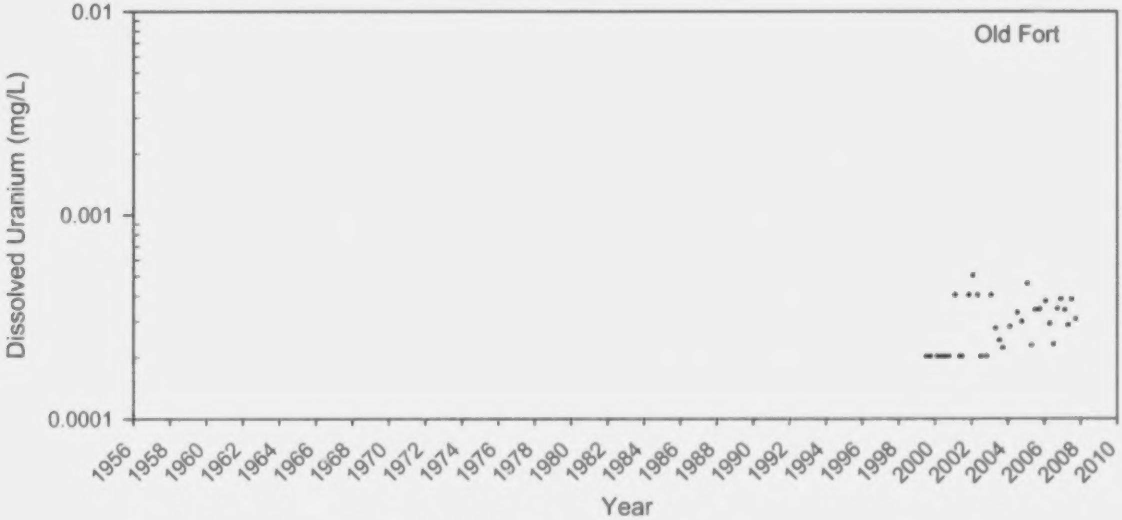


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00053		
Flow Adjusted								

Figure 246 Total uranium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.

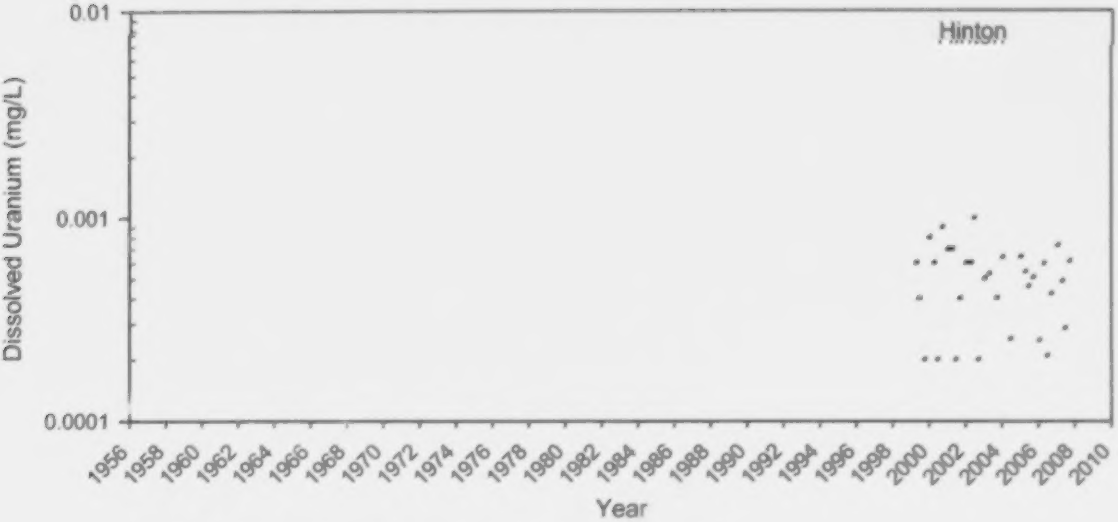


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00041		
Flow Adjusted								

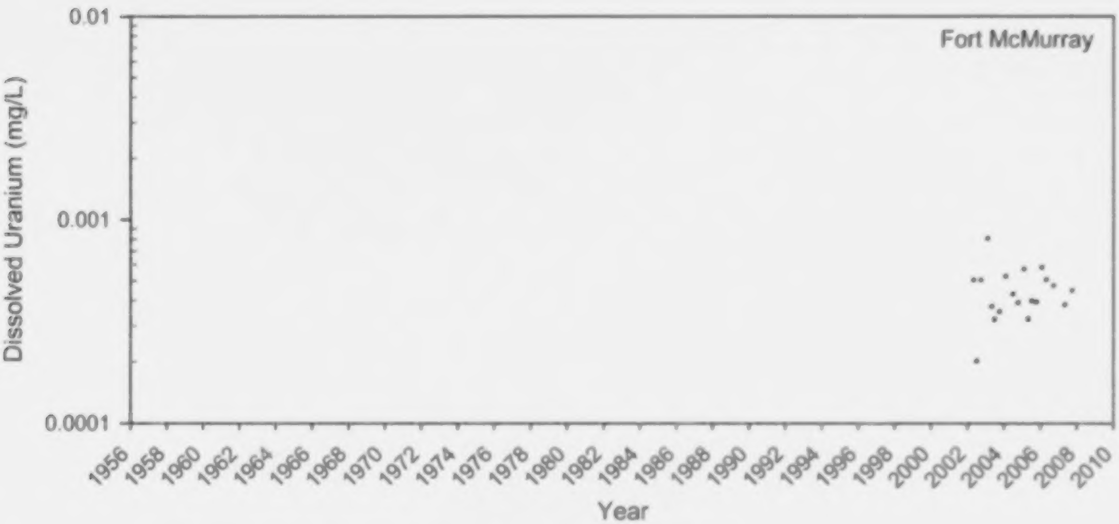


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
						0.00029		
Flow Adjusted								

Figure 247 Dissolved uranium concentration in the Athabasca River at Athabasca and Old Fort. Data are insufficient for trend analysis at this time.

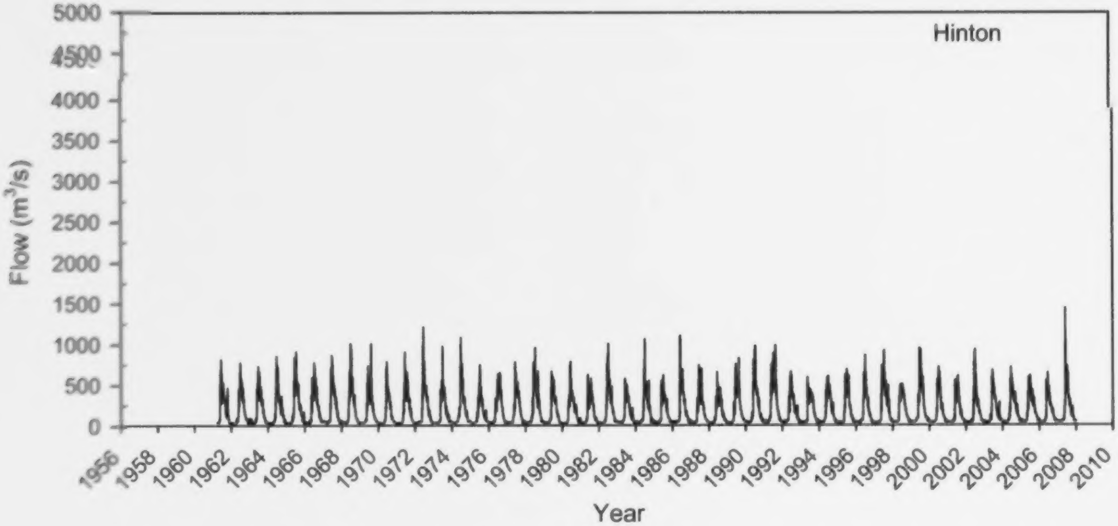


Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.00051		
Flow Adjusted								



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig	Significance	Median	Slope	Sig	Median	Slope	Sig
						0.00043		
Flow Adjusted								

Figure 248 Dissolved uranium concentration in the Athabasca River at Hinton and Fort McMurray. Data are insufficient for trend analysis at this time.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
0.0320	NS							
Flow Adjusted								

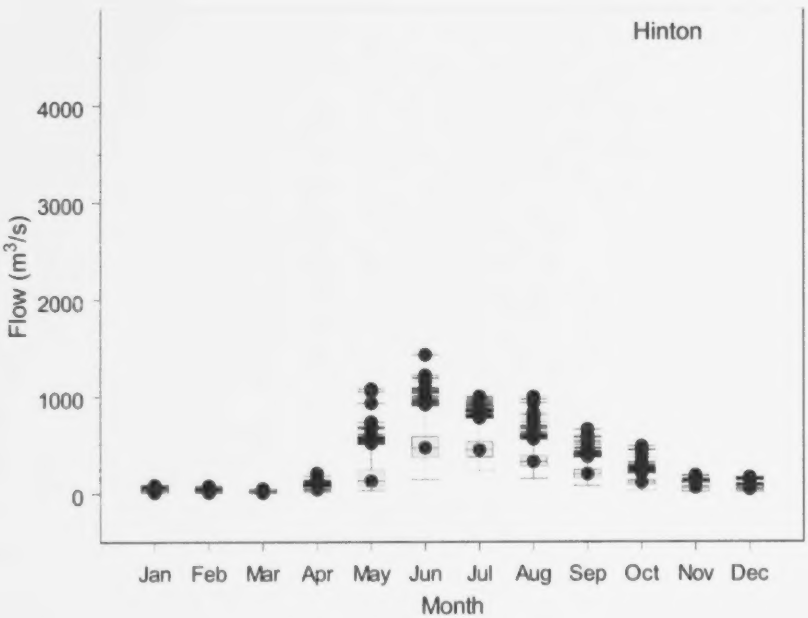
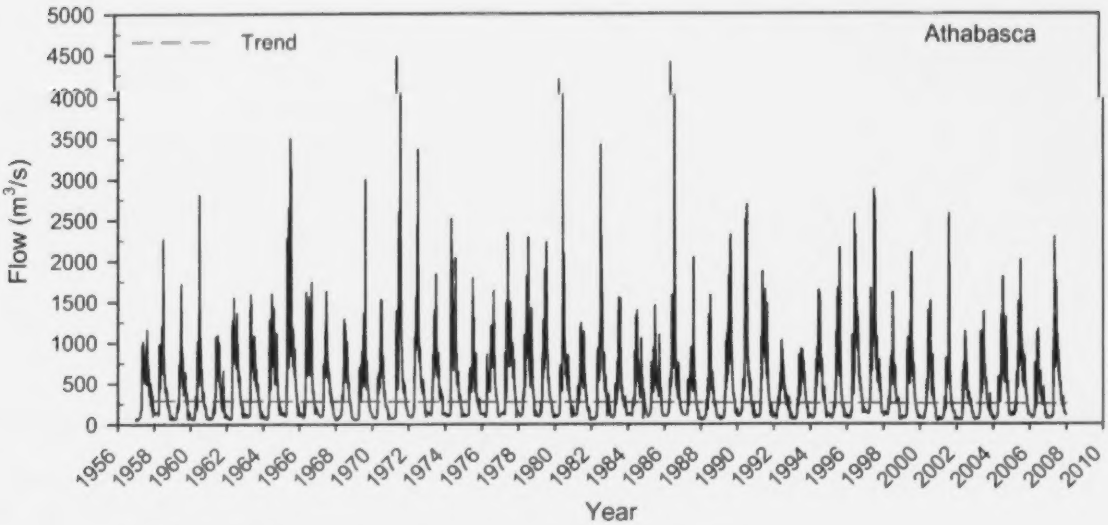


Figure 249 Stream flow and seasonality of stream flow in the Athabasca River at Hinton. Presented data are based on daily means for the period 1961-2008, as reported by the Water Survey of Canada.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig	Median	Slope	Sig
-0.9250	down							
Flow Adjusted								

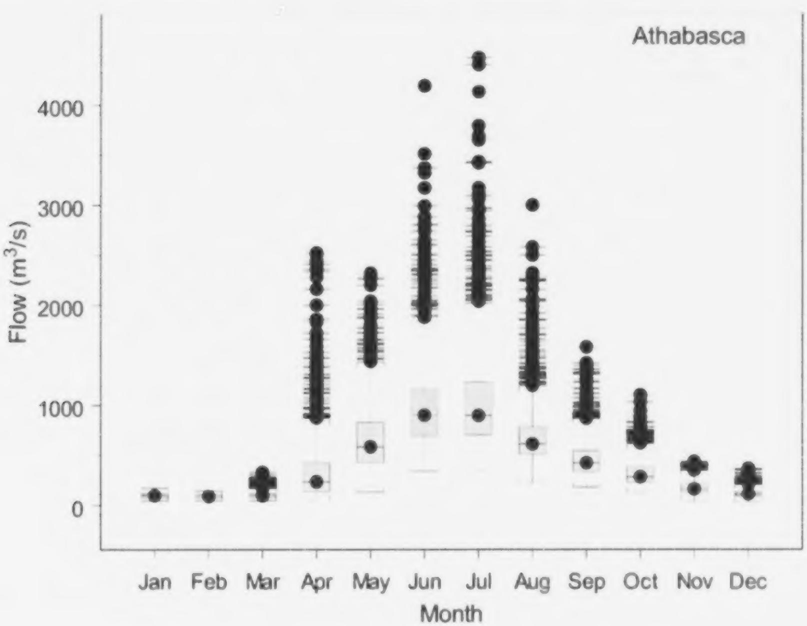
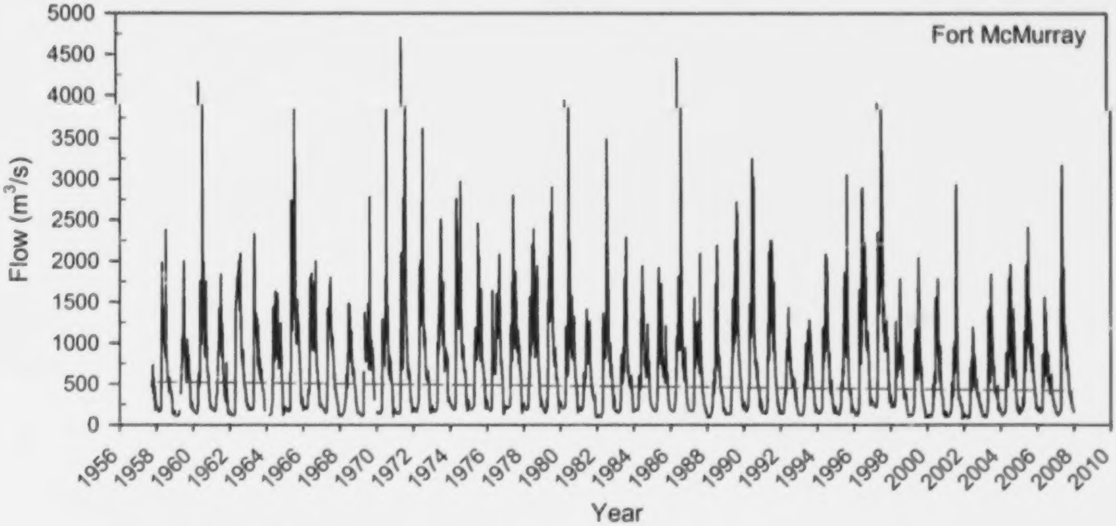


Figure 250 Stream flow and seasonality of stream flow in the Athabasca River at Athabasca. Presented data are based on daily means for the period 1961-2008, as reported by the Water Survey of Canada.



Overall Trend		1987 Step Trend	Pre-1987 Trend			Post-1987 Trend		
Slope	Sig.	Significance	Median	Slope	Sig.	Median	Slope	Sig.
-2.1667	down							
Flow Adjusted								

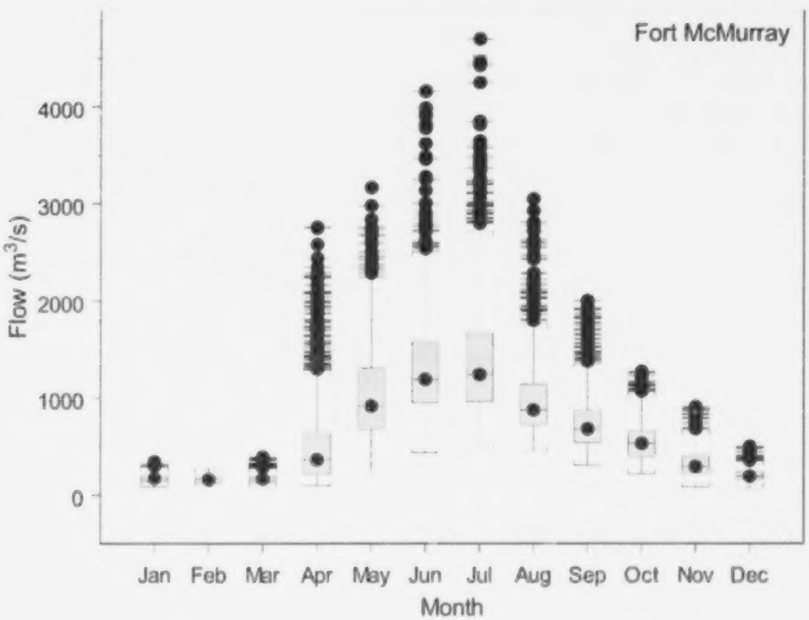


Figure 251 Stream flow and seasonality of stream flow in the Athabasca River upstream of Fort McMurray. Presented data are based on daily means for the period 1961-2008, as reported by the Water Survey of Canada.

Appendix I Step analysis of routine water quality data collected at the Athabasca sampling site: pre-January 1987 vs. post-January 1987. Significance of the step is depicted at 90% (*), 95% (**), and 99% (***). NS = Not Significant, ID = Insufficient Data.

Variable	Est. Diff. Btwn Time Periods	Median 1	Median 2	sig.
Temperature	-0.2000	6.0000	4.6950	**
pH	-0.0300	7.9200	7.9100	NS
Conductivity	13.0000	290.0000	294.0000	***
Total Alkalinity	8.0000	123.0000	127.0000	***
Hardness	4.4300	138.8500	140.0000	***
DO	0.1800	9.9500	9.9150	**
Turbidity	0.2000	7.0000	7.4000	NS
Non-Filterable Residue	-2.0000	18.0000	7.8000	***
TDS	ID	-	-	-
Filterable Residue	ID	-	-	-
Potassium	0.0000	1.4000	1.3000	NS
Sodium	2.4000	7.3000	9.9000	***
Calcium	0.6000	38.9000	38.5000	NS
Magnesium	0.4000	10.4000	10.4000	***
Bicarbonate	ID	-	-	-
Carbonate	ID	-	-	-
Chloride	-0.1000	2.4000	2.5000	**
Fluoride	0.0100	0.1000	0.1100	***
Sulphate	5.0000	26.3500	29.5000	***
Reactive Silica	-0.3000	4.9000	4.5800	***
Total Organic Carbon	-3.4000	10.0000	6.6500	***
Dissolved Organic Carbon	0.0000	6.0000	6.1000	NS
Particulate Nitrogen	0.0000	0.0800	0.0800	NS
Dissolved Nitrogen	ID	-	-	-
Dissolved Kjeldahl Nitrogen	ID	-	-	-
Total Ammonia Nitrogen	-0.0300	0.0500	0.0200	***
Total Kjeldahl Nitrogen	ID	-	-	-
Nitrite and Nitrate	0.0000	0.0400	0.0410	NS
Total Nitrogen	-0.1450	0.5500	0.3980	***
Total Phosphorus	-0.0020	0.0310	0.0250	NS
Total Dissolved Phosphorus	0.0020	0.0060	0.0080	***
Chlorophyll a	-0.0020	0.0020	0.0020	**
Total Coliforms	16.0000	16.0000	48.0000	***
Fecal Coliforms	2.0000	4.0000	5.0000	***
Escherichia coli	ID	-	-	-

Appendix II Step analysis of routine water quality data collected at the Old Fort sampling site: pre-January 1987 vs. post-January 1987. Significance of the step is depicted at 90% (*), 95% (**), and 99% (***). NS = Not Significant, ID = Insufficient Data.

Variable	Est. Diff. Btwn Time Periods	Median 1	Median 2	sig.
Temperature	0.0000	8.0000	1.6000	NS
pH	-0.0500	7.7500	7.7200	NS
Conductivity	19.0000	288.0000	309.5000	***
Total Alkalinity	1.0000	108.0000	113.5000	NS
Hardness	1.1400	113.4100	122.8100	NS
DO	ID	-	-	-
Turbidity	ID	-	-	-
Non-Filterable Residue	-2.0000	28.0000	22.0000	**
TDS	ID	-	-	-
Filterable Residue	0.0000	189.0000	188.0000	NS
Potassium	0.1000	1.1500	1.2800	**
Sodium	2.2000	14.9000	18.7500	***
Calcium	0.1500	31.6000	33.7000	NS
Magnesium	0.1000	8.7000	9.5450	NS
Bicarbonate	ID	-	-	-
Carbonate	ID	-	-	-
Chloride	1.3000	14.3000	16.0500	**
Fluoride	ID	-	-	-
Sulphate	2.5500	21.5000	24.9000	***
Reactive Silica	0.1000	5.8000	5.8400	NS
Total Organic Carbon	-0.7000	9.7500	7.8000	NS
Dissolved Organic Carbon	-0.9000	10.0000	8.0000	**
Particulate Nitrogen	ID	-	-	-
Dissolved Nitrogen	ID	-	-	-
Dissolved Kjeldahl Nitrogen	ID	-	-	-
Total Ammonia	ID	-	-	-
Total Kjeldahl Nitrogen	-0.2300	0.7000	0.4700	***
Nitrite and Nitrate	-0.0075	0.0525	0.0475	***
Total Nitrogen	-0.4560	1.0500	0.5700	***
Total Phosphorus	-0.0030	0.0485	0.0475	NS
Total Dissolved Phosphorus	ID	-	-	-
Chlorophyll a	ID	-	-	-
Total Coliforms	ID	-	-	-
Fecal Coliforms	ID	-	-	-
Escherichia coli	ID	-	-	-

Appendix III Results of trend analyses for routine variables at the Athabasca sampling site, 1958-2008. Significance was determined at a 95% confidence interval. Seaken = Seasonal Kendall Analysis, Tobit = Tobit regression (for censored data).

Variable	Trend Test	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Flow	Seaken	1958	50	12	562	-0.500000	-0.180505	0.218572	none
Temperature	Seaken	1960	48	12	498	-0.017895	-0.447368	0.000001	**down**
pH	Seaken	1960	48	12	526	0.000000	0.000000	0.644566	none
Conductivity	Seaken	1960	48	12	506	0.391304	0.134008	0.014162	**up**
Alkalinity	Seaken	1960	48	12	501	0.285714	0.230415	0.000052	**up**
Hardness	Seaken	1960	48	12	506	0.084666	0.060944	0.211126	none
Dissolved Oxygen	Seaken	1978	30	12	336	0.007778	0.077777	0.172519	none
Turbidity	Seaken	1960	48	12	504	0.012593	0.170170	0.314166	none
True Colour	Seaken	1981	27	12	287	0.000000	0.000000	0.009541	**down**
Non-Filterable Residue	Tobit	1977	31	NA	348	NA	-0.316347	0.609885	none
Total Dissolved Solids	Seaken	1997	10	12	114	-1.285714	-0.734694	0.276369	none
Filterable Residue	Seaken	1987	21	12	221	1.410526	0.742382	0.033310	**up**
Potassium	Seaken	1960	48	12	507	0.000000	0.000000	0.671266	none
Sodium	Seaken	1960	48	12	508	0.086000	1.022592	0.000000	**up**
Calcium	Seaken	1960	48	12	507	0.015385	0.039960	0.479332	none
Magnesium	Seaken	1977	31	12	346	0.035714	0.346741	0.023089	**up**
Bicarbonate	Seaken	1985	23	12	251	0.412777	0.269789	0.059559	none
Chloride	Seaken	1960	48	12	506	-0.007407	-0.308642	0.044797	**down**
Fluoride	Seaken	1978	30	12	337	0.000526	0.478469	0.034270	**up**
Sulphate	Seaken	1960	48	12	507	0.155556	0.563607	0.002450	**up**
Reactive Silica	Seaken	1960	40	12	410	-0.014807	-0.308488	0.033906	**down**
Total Organic Carbon	Seaken	1977	23	1	23	-0.022222	-0.317460	0.894834	none
Dissolved Organic Carbon	Seaken	1977	31	12	342	0.000000	0.000000	0.955316	none
Total Kjeldahl Nitrogen	Seaken	1987	21	12	227	-0.004000	-1.152738	0.087288	none
Nitrate + Nitrite Nitrogen	Tobit	1965	43	NA	454	NA	-0.887164	0.057950	none
Total Nitrogen	Seaken	1977	31	12	344	0.001640	0.409903	0.205313	none
Total Phosphorus	Seaken	1977	31	12	345	0.000000	0.000000	0.739758	none
Total Dissolved Phosphorus	Tobit	1977	31	NA	342	NA	1.909902	0.000054	**up**
Chlorophyll *a*	Seaken	1980	28	12	310	0.000000	0.000000	0.722004	none
Total Coliform Bacteria	Seaken	1977	22	12	223	0.571429	1.587302	0.264250	none
Fecal Coliform Bacteria	Tobit	1977	31	NA	341	NA	2.577562	0.007055	**up**

Appendix IV Results of trend analyses on routine variables at the Old Fort sampling site, 1977-2008. Significance was determined at a 95% confidence interval. Seaken = Seasonal Kendall Analysis, Tobit = Tobit regression (for censored data).

Variable	Trend Test	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Flow	Seaken	1978	30	12	321	-3.466667	-0.851761	0.024194	**down**
Temperature	Seaken	1978	30	1	28	0.000000	NA	0.012256	**down**
pH	Seaken	1978	30	12	263	0.005000	0.064684	0.197502	none
Conductivity	Seaken	1978	30	12	240	-0.052632	-0.017060	0.888696	none
Alkalinity	Seaken	1978	30	12	260	0.000000	0.000000	0.907478	none
Hardness	Seaken	1977	31	12	264	-0.030769	-0.025547	0.568158	none
Dissolved Oxygen	Seaken	1987	21	1	21	-0.044688	-0.414157	0.290561	none
Turbidity	Seaken	1987	21	12	205	0.175000	1.250000	0.044619	**up**
True Colour	Seaken	1987	21	12	204	0.000000	0.000000	0.247284	none
Non-filterable Residue	Seaken	1977	31	12	264	0.029630	0.134680	0.518199	none
Filterable Residue	Seaken	1977	31	12	250	0.250000	0.131926	0.522497	none
Potassium	Seaken	1987	21	12	207	0.010000	0.769230	0.058178	none
Sodium	Seaken	1977	31	12	265	0.077222	0.433833	0.080535	none
Calcium	Seaken	1977	31	12	265	-0.031981	-0.095464	0.419616	none
Magnesium	Seaken	1977	31	12	264	0.000000	0.000000	0.942194	none
Bicarbonate	Seaken	1987	21	12	207	0.000000	0.000000	0.989507	none
Chloride	Seaken	1977	31	12	265	0.000000	0.000000	0.948368	none
Fluoride	Seaken	1987	21	1	21	-0.002222	-1.851852	0.119429	none
Sulphate	Seaken	1977	31	12	265	0.143304	0.592164	0.036560	**up**
Reactive Silica	Seaken	1977	23	1	21	0.024599	0.294598	0.716627	none
Total Organic Carbon	Seaken	1977	23	1	20	0.050000	0.689655	0.416814	none
Dissolved Organic Carbon	Seaken	1987	21	12	204	0.000000	0.000000	0.937561	none
Total Ammonia Nitrogen	Tobit	1987	21	NA	205	NA	4.067641	0.000010	**up**
Total Kjeldahl Nitrogen	Seaken	1987	21	12	204	0.000690	0.146910	0.692046	none
Nitrite + Nitrate Nitrogen	Tobit	1988	20	NA	206	NA	2.236576	0.169873	none
Total Nitrogen	Seaken	1977	31	12	260	0.001000	0.175131	0.757810	none
Total Phosphorus	Seaken	1977	31	12	264	0.000100	0.208333	0.476650	none
Total Dissolved Phosphorus	Seaken	1987	21	12	204	-0.000125	-1.041667	0.144305	none
Chlorophyll *a*	Seaken	1987	21	1	21	0.000000	0.000000	0.736817	none

Appendix V Results of Seasonal Kendall analyses on flow adjusted data for routine variables at the Athabasca sampling site, **1960-2008**. Significance was determined at a 95% confidence interval.

Variable	Flow Model	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Temperature	log	1960	48	12	498	0.004144	0.103610	0.821477	none
pH	inverse	1960	48	12	526	-0.000300	-0.003783	0.732579	none
Conductivity	hyperbolic 4	1960	48	12	506	0.272523	0.093330	0.029144	**up**
Alkalinity	hyperbolic 4	1960	48	12	501	0.240496	0.193948	0.000764	**up**
Hardness	hyperbolic 4	1960	48	12	506	-0.007254	-0.005221	0.914137	none
Dissolved Oxygen	hyperbolic 2	1978	30	12	336	0.004777	0.047770	0.311819	none
Turbidity	loess	1960	48	12	504	0.048231	0.651771	0.003923	**up**
Non-Filterable Residue	loess	1977	31	12	342	0.007970	0.080143	0.834577	none
Filterable Residue	hyperbolic 4	1987	21	12	221	1.381472	0.727091	0.016258	**up**
Potassium	hyperbolic 3	1960	48	12	507	-0.001650	-0.125004	0.445297	none
Sodium	hyperbolic 4	1960	48	12	508	0.094385	1.122300	0.000000	**up**
Calcium	hyperbolic 4	1960	48	12	507	-0.010836	-0.028145	0.592034	none
Magnesium	hyperbolic 4	1977	31	12	346	0.008338	0.080947	0.400050	none
Bicarbonate	hyperbolic 4	1985	23	12	251	0.129966	0.084945	0.504289	none
Chloride	hyperbolic 4	1960	48	12	506	-0.013835	-0.576449	0.003167	**down**
Fluoride	hyperbolic 4	1978	30	12	337	0.000498	0.452308	0.085733	none
Sulphate	hyperbolic 4	1960	48	12	507	0.107695	0.390198	0.000594	**up**
Reactive Silica	inverse	1960	40	12	410	-0.014150	-0.294782	0.072083	none
Total Organic Carbon	hyperbolic 1	1977	23	1	23	0.016622	0.237459	0.915867	none
Dissolved Organic Carbon	linear	1977	31	12	342	0.005652	0.093414	0.741461	none
Total Kjeldahl Nitrogen	linear	1987	21	12	227	-0.004444	-1.280757	0.031263	**down**
Nitrate + Nitrite Ntirogen	inverse	1965	43	12	440	0.000089	0.223022	0.345105	none
Total Nitrogen	linear	1977	31	12	344	0.001902	0.475484	0.158997	none
Total Phosphorus	linear	1977	31	12	345	0.000340	1.358692	0.039533	**up**
Total Dissolved Phosphorus	inverse	1977	31	12	339	0.000066	0.940757	0.105389	none
Chlorophyll *a*	hyperbolic 4	1980	28	12	310	0.000019	0.992936	0.082519	none
Total Coliform Bacteria	linear	1977	22	12	223	0.344578	0.957161	0.704523	none
Fecal Coliform Bacteria	linear	1977	31	12	339	0.322600	3.226002	0.000086	**up**

Appendix VI Results of Seasonal Kendall analyses on flow adjusted data for routine variables at the Old Fort sampling site, **1977-2008**. Significance was determined at a 95% confidence interval.

Variable	Flow Model	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Temperature	log	1978	30	1	28	0.045774	Inf	0.373980	none
pH	inverse	1978	30	12	263	0.006329	0.081873	0.154324	none
Conductivity	hyperbolic 4	1978	30	12	240	-0.855095	-0.277178	0.016410	**down**
Alkalinity	hyperbolic 4	1978	30	12	260	-0.126959	-0.114377	0.352812	none
Hardness	hyperbolic 4	1977	31	12	264	-0.288010	-0.239132	0.023234	down
Dissolved Oxygen	hyperbolic 3	1987	21	1	21	-0.072931	-0.675917	0.174190	none
Turbidity	loess	1987	21	12	205	0.260828	1.863057	0.039481	**up**
Non-Filterable Residue	loess	1977	31	12	264	0.029630	0.134680	0.518199	none
Total Dissolved Solids	hyperbolic 4	1997	10	12	105	-0.326720	-0.180508	0.800122	none
Filterable Residue	hyperbolic 4	1977	31	12	250	-0.285157	-0.150479	0.435793	none
Potassium	hyperbolic 4	1987	21	12	207	0.009924	0.763351	0.065628	none
Sodium	hyperbolic 4	1977	31	12	265	0.000094	0.000531	1.000000	none
Calcium	hyperbolic 4	1977	31	12	265	-0.091991	-0.274600	0.026145	**down**
Magnesium	hyperbolic 4	1977	31	12	264	-0.013052	-0.139596	0.227279	none
Bicarbonate	hyperbolic 4	1987	21	12	207	-0.027084	-0.019485	0.925037	none
Chloride	hyperbolic 5	1977	31	12	265	-0.089748	-0.560923	0.002499	**down**
Sulphate	hyperbolic 4	1977	31	12	265	0.069729	0.288138	0.121303	none
Reactive Silica	hyperbolic 7	1977	23	1	21	-0.015995	-0.191560	0.785797	none
Total Organic Carbon	hyperbolic 2	1977	23	1	20	0.032838	0.452944	0.581255	none
Dissolved Organic Carbon	linear	1987	21	12	204	0.020069	0.244742	0.563884	none
Total Kjeldahl Nitrogen	loess	1987	21	12	204	0.002614	0.556109	0.200477	none
Nitrate + Nitrite Nitrogen	inverse	1977	31	12	262	-0.000372	-0.767596	0.432021	none
Total Nitrogen	loess	1977	31	12	260	0.002041	0.357459	0.429228	none
Total Phosphorus	loess	1977	31	12	264	0.000324	0.675682	0.009031	**up**

Appendix VII Results of trend analyses for routine variables at the Athabasca sampling site, **1960-19**= Seasonal Kendall Analysis, Tobit = Tobit regression (for censored data).

Variable	Trend Test	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Temperature	Seaken	1961	26	12	258	-0.025000	-0.757576	0.002109	**down**
pH	Seaken	1960	27	12	293	0.000000	0.000000	0.932131	none
Conductivity	Seaken	1961	26	12	267	-0.153947	-0.053269	0.636622	none
Alkalinity	Seaken	1961	26	12	261	0.000000	0.000000	0.800363	none
Hardness	Seaken	1960	27	12	278	-0.313992	-0.228335	0.031300	down
Dissolved Oxygen	Seaken	1976	11	12	122	0.000000	0.000000	0.971240	none
Turbidity	Seaken	1961	26	12	265	0.110556	1.381944	0.001144	**up**
Non-Filterable Residue	Tobit	1977	10	NA	109	NA	6.558247	0.016106	**up**
Potassium	Seaken	1961	26	12	267	0.000000	0.000000	0.260602	none
Sodium	Seaken	1961	26	12	268	0.022727	0.311333	0.070239	none
Calcium	Seaken	1961	26	12	267	-0.051191	-0.131595	0.305770	none
Magnesium	Seaken	1976	11	12	123	-0.100000	-1.052631	0.122372	none
Chloride	Seaken	1960	27	12	279	0.000000	0.000000	0.569935	none
Sulphate	Seaken	1961	26	12	267	-0.166667	-0.641026	0.046675	**down**
Reactive Silica	Seaken	1961	26	12	262	-0.020000	-0.416668	0.083497	none
Total Organic Carbon	Seaken	1977	10	1	10	0.200000	2.773925	1.000000	none
Dissolved Organic Carbon	Seaken	1977	10	12	116	-0.100000	-1.666666	0.182044	none
Nitrate + Nitrite Nitrogen	Tobit	1966	21	NA	209	NA	0.911040	0.435777	none
Total Nitrogen	Seaken	1977	10	12	117	-0.010000	-2.941177	0.137387	none
Total Phosphorus	Seaken	1977	10	12	117	0.000000	0.000000	0.810093	none
Total Dissolved Phosphorus	Tobit	1977	10	NA	102	NA	0.171042	0.934877	none
Total Coliform Bacteria	Seaken	1977	10	12	97	-1.250000	-7.812500	0.381796	none
Fecal Coliform Bacteria	Tobit	1977	10	NA	100	NA	2.613872	0.629244	none

Appendix VIII Results of Seasonal Kendall analyses on flow adjusted data for routine variables at the Athabasca sampling site, **1960-1987**. Significance was determined at a 95% confidence interval. Seaken = Seasonal Kendall Analysis, Tobit = Tobit regression (for censored data).

Variable	Flow Model	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Temperature	log	1961	26	12	258	-0.095437	-2.892022	0.011968	**down**
pH	inverse	1960	27	12	293	-0.000601	-0.007593	0.703274	none
Conductivity	hyperbolic 4	1961	26	12	267	0.422189	0.146086	0.137952	none
Alkalinity	hyperbolic 4	1961	26	12	261	0.261994	0.218328	0.109787	none
Hardness	hyperbolic 4	1960	27	12	278	-0.016238	-0.011808	0.915733	none
Dissolved Oxygen	hyperbolic 2	1976	11	12	122	0.000459	0.004567	1.000000	none
Turbidity	loess	1961	26	12	265	0.080115	1.001438	0.057423	none
Non-Filterable Residue	loess	1977	10	12	114	0.149981	0.999873	0.445229	none
Potassium	hyperbolic 3	1961	26	12	267	-0.002196	-0.156886	0.629725	none
Sodium	hyperbolic 4	1961	26	12	268	0.063340	0.867676	0.003149	**up**
Calcium	hyperbolic 4	1961	26	12	267	-0.002060	-0.005295	0.996019	none
Magnesium	hyperbolic 4	1976	11	12	123	-0.092629	-0.975044	0.037215	**down**
Chloride	hyperbolic 4	1960	27	12	279	0.007067	0.294476	0.391582	none
Sulphate	hyperbolic 4	1961	26	12	267	-0.120741	-0.464389	0.038380	**down**
Reactive Silica	inverse	1961	26	12	262	-0.017122	-0.356699	0.213055	none
Total Organic Carbon	hyperbolic 1	1977	10	1	10	0.040349	0.559621	1.000000	none
Dissolved Organic Carbon	linear	1977	10	12	116	-0.077142	-1.285704	0.232915	none
Nitrate + Nitrite Nitrogen	inverse	1966	21	12	202	0.000985	2.462715	0.027502	**up**
Total Nitrogen	linear	1977	10	12	117	-0.010303	-3.030426	0.118555	none
Total Phosphorus	linear	1977	10	12	117	-0.000516	-2.148466	0.105244	none
Total Dissolved Phosphorus	inverse	1977	10	12	111	0.000065	1.088023	0.345129	none
Total Coliform Bacteria	linear	1977	10	12	97	-5.841733	-36.510830	0.050837	none
Fecal Coliform Bacteria	linear	1977	10	12	109	-0.071525	-1.788116	0.571955	none

Appendix IX Results of trend analyses for routine variables at the Athabasca sampling site, **1987-2008** . Significance was determined at a 95% confidence interval. Seaken = Seasonal Kendall Analysis, Tobit = Tobit regression (for censored data).

Variable	Trend Test	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Temperature	Seaken	1987	21	12	228	-0.009333	-0.198793	0.150177	none
pH	Seaken	1987	21	12	233	0.000000	0.000000	0.847937	none
Conductivity	Seaken	1987	21	12	227	0.225000	0.076014	0.690111	none
Alkalinity	Seaken	1987	21	12	228	0.214286	0.168729	0.337543	none
Hardness	Seaken	1987	21	12	228	0.130769	0.093406	0.348972	none
Dissolved Oxygen	Seaken	1987	21	12	231	0.015227	0.152731	0.161194	none
Turbidity	Seaken	1987	21	12	227	-0.087500	-1.250000	0.049057	**down**
True Colour	Seaken	1987	21	12	224	0.000000	0.000000	0.160509	none
Non-Filterable Residue	Tobit	1987	21	NA	239	NA	-0.867685	0.448544	none
Filterable Residue	Seaken	1987	21	12	221	1.410526	0.742382	0.033310	**up**
Potassium	Seaken	1987	21	12	228	0.003750	0.288461	0.315951	none
Sodium	Seaken	1987	21	12	228	0.128750	1.274753	0.018704	**up**
Calcium	Seaken	1987	21	12	228	0.080000	0.204603	0.387408	none
Magnesium	Seaken	1987	21	12	228	0.025000	0.235848	0.461420	none
Bicarbonate	Seaken	1987	21	12	228	0.300000	0.193667	0.260937	none
Chloride	Seaken	1987	21	12	227	-0.033333	-1.333333	0.077975	none
Fluoride	Seaken	1987	21	12	230	0.000000	0.000000	0.482128	none
Sulphate	Seaken	1987	21	12	228	0.392308	1.303347	0.022276	**up**
Reactive Silica	Seaken	1987	13	12	136	-0.014286	-0.308880	0.725176	none
Total Organic Carbon	Seaken	1987	12	1	12	0.200000	2.898551	0.216006	none
Dissolved Organic Carbon	Seaken	1987	21	12	226	0.000000	0.000000	0.876631	none
Total Ammonia Nitrogen	Tobit	1987	21	NA	236	NA	3.000660	0.002385	**up**
Total Kjeldahl Nitrogen	Seaken	1987	21	12	227	-0.004000	-1.152738	0.087288	none
Nitrate + Nitrite Nitrogen	Tobit	1987	21	NA	239	NA	-0.103093	0.943581	none
Total Nitrogen	Seaken	1987	21	12	227	-0.002667	-0.617284	0.258942	none
Total Phosphorus	Seaken	1987	21	12	228	-0.000111	-0.435730	0.533216	none
Total Dissolved Phosphorus	Tobit	1987	21	NA	240	NA	0.541914	0.524819	none
Chlorophyll *a*	censored	1987	21	12	229	0.000000	0.000000	0.744875	none
Total Coliform Bacteria	Seaken	1987	12	12	126	-4.000000	-7.920792	0.102911	none
Fecal Coliform Bacteria	Tobit	1987	21	NA	241	NA	0.583032	0.709800	none

Appendix X Results of trend analyses for routine variables at the Old Fort sampling site, **1987-2008**. Significance was determined at a 95% confidence interval. Seaken = Seasonal Kendall Analysis, Tobit = Tobit regression (for censored data).

Variable	Trend Test	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Temperature	Seaken	1987	21	1	21	-0.002812	-Inf	0.048277	**down**
pH	Seaken	1987	21	12	210	0.015000	0.194427	0.033254	**up**
Conductivity	Seaken	1987	21	12	187	-0.933333	-0.299145	0.226815	none
Alkalinity	Seaken	1987	21	12	207	0.000000	0.000000	0.911654	none
Hardness	Seaken	1987	21	12	206	-0.097084	-0.079023	0.401463	none
Dissolved Oxygen	Seaken	1987	21	1	21	-0.044688	-0.414157	0.290561	none
Turbidity	Seaken	1987	21	12	205	0.175000	1.250000	0.044619	**up**
True Colour	Seaken	1987	21	12	204	0.000000	0.000000	0.247284	none
Non-Filterable Residue	Seaken	1987	21	12	207	0.250000	1.136364	0.026868	**up**
Total Dissolved Solids	Seaken	1997	10	12	105	-2.200000	-1.215470	0.107045	none
Filterable Residue	Seaken	1987	21	12	201	0.500000	0.265957	0.422512	none
Potassium	Seaken	1987	21	12	207	0.010000	0.769231	0.058178	none
Sodium	Seaken	1987	21	12	207	0.028571	0.145033	0.738467	none
Calcium	Seaken	1987	21	12	207	-0.075000	-0.222551	0.203487	none
Magnesium	Seaken	1987	21	12	207	0.000000	0.000000	0.824791	none
Bicarbonate	Seaken	1987	21	12	207	0.000000	0.000000	0.989507	none
Chloride	Seaken	1987	21	12	207	-0.080000	-0.467836	0.316435	none
Fluoride	Seaken	1987	21	1	21	-0.002222	-1.851852	0.119429	none
Sulphate	Seaken	1987	21	12	207	0.175000	0.688977	0.159127	none
Reactive Silica	Seaken	1987	13	1	13	-0.168750	-2.008928	0.427711	none
Total Organic Carbon	Seaken	1987	12	1	11	0.200000	2.564103	0.050918	none
Dissolved Organic Carbon	Seaken	1987	21	12	204	0.000000	0.000000	0.937561	none
Total Ammonia Nitrogen	Tobit	1987	21	NA	205	NA	4.067641	0.000010	**up**
Total Kjeldahl Nitrogen	Seaken	1987	21	12	204	0.000690	0.146910	0.692046	none
Nitrate + Nitrite Nitrogen	Tobit	[illegible]	21	NA	214	NA	4.035744	0.013890	**up**
Total Nitrogen	Seaken	1987	21	12	204	0.002589	0.453732	0.349260	none
Total Phosphorus	Seaken	1987	21	12	207	0.000357	0.776398	0.149698	none
Total Dissolved Phosphorus	Tobit	1987	21	NA	213	NA	-0.646606	0.360707	none
Chlorophyll *a*	Seaken	1987	21	1	21	0.000000	0.000000	0.736817	none
Total Coliform Bacteria	Seaken	1987	13	1	13	-4.500000	-11.538462	0.023988	**down**
Fecal Coliform Bacteria	Tobit	1987	21	NA	182	NA	5.717408	0.000010	**up**

Appendix XI Results of Seasonal Kendall analyses on flow adjusted data for routine variables at the Athabasca sampling site, **1987-2008**. Significance was determined at a 95% confidence interval.

Variable	Flow Model	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Temperature	log	1987	21	12	228	0.044322	0.944026	0.587800	none
pH	inverse	1987	21	12	233	0.000473	0.005966	0.899230	none
Conductivity	hyperbolic 4	1987	21	12	227	0.145900	0.049290	0.644963	none
Alkalinity	hyperbolic 4	1987	21	12	228	0.147043	0.115782	0.411513	none
Hardness	hyperbolic 4	1987	21	12	228	0.088480	0.063200	0.725998	none
Dissolved Oxygen	hyperbolic 2	1987	21	12	231	0.012295	0.123316	0.179593	none
Turbidity	loess	1987	21	12	227	-0.089994	-1.285634	0.019435	**down**
Non-Filterable Residue	loess	1987	21	12	228	-0.049268	-0.679561	0.420023	none
Total Dissolved Solids	hyperbolic 4	1997	10	12	114	0.171059	0.097748	0.889344	none
Filterable Residue	hyperbolic 4	1987	21	12	221	1.381472	0.727091	0.016258	**up**
Potassium	hyperbolic 3	1987	21	12	228	0.007113	0.547120	0.366113	none
Sodium	hyperbolic 4	1987	21	12	228	0.117554	1.163903	0.004607	**up**
Calcium	hyperbolic 4	1987	21	12	228	0.020489	0.052402	0.805305	none
Magnesium	hyperbolic 4	1987	21	12	228	0.015459	0.145841	0.465447	none
Bicarbonate	hyperbolic 4	1987	21	12	228	0.257217	0.166048	0.305318	none
Chloride	hyperbolic 4	1987	21	12	227	-0.041599	-1.663968	0.033233	**down**
Fluoride	hyperbolic 4	1987	21	12	230	-0.000361	-0.328412	0.577634	none
Sulphate	hyperbolic 4	1987	21	12	228	0.353434	1.174199	0.001222	**up**
Reactive Silica	inverse	1987	13	12	136	0.000799	0.017279	1.000000	none
Total Organic Carbon	hyperbolic 1	1987	21	1	21	0.023089	0.339544	0.785797	none
Dissolved Organic Carbon	linear	1987	21	12	226	-0.003328	-0.054555	0.912655	none
Total Ammonia Nitrogen	linear	1987	21	12	225	0.000000	0.000000	0.041106	**down**
Total Kjeldahl Nitrogen	inverse	1987	21	12	227	-0.004444	-1.280757	0.031263	**down**
Nitrate + Nitrite Nitrogen	linear	1987	21	12	227	0.000694	1.693383	0.070225	none
Total Nitrogen	linear	1987	21	12	227	-0.002675	-0.619321	0.187494	none
Total Phosphorus	inverse	1987	21	12	228	-0.000195	-0.764909	0.481979	none
Total Dissolved Phosphorus	hyperbolic 4	1987	21	12	228	0.000020	0.248892	0.744747	none
Chlorophyll *a*	linear	1987	21	12	229	0.000018	0.916792	0.279320	none
Total Coliform Bacteria	linear	1987	12	12	126	-5.082899	-10.065150	0.061636	none
Fecal Coliform Bacteria	linear	1987	21	12	230	0.210093	2.100928	0.103200	none

Appendix XII Results of Seasonal Kendall analyses on flow adjusted data for routine variables at the Old Fort sampling site, **1987-2008**. Significance was determined at a 95% confidence interval.

Variable	Flow Model	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Temperature	log	1987	21	1	21	0.032698	3269833	0.650582	none
pH	inverse	1987	21	12	210	0.015045	0.195010	0.029382	up
Conductivity	hyperbolic 4	1987	21	12	187	-1.244659	-0.398929	0.041753	down
Alkalinity	hyperbolic 4	1987	21	12	207	-0.015343	-0.013459	0.946230	none
Hardness	hyperbolic 4	1987	21	12	206	-0.291359	-0.237157	0.104966	none
Dissolved Oxygen	hyperbolic 3	1987	21	1	21	-0.072931	-0.675917	0.174190	none
Turbidity	loess	1987	21	12	205	0.260828	1.863057	0.039481	up
Non-Filterable Residue	loess	1987	21	12	207	0.367911	1.672323	0.021292	up
Total Dissolved Solids	loess	1996	12	12	117	-0.668554	-0.371419	0.443552	none
Filterable Residue	hyperbolic 4	1987	21	12	201	0.430899	0.229202	0.439194	none
Potassium	hyperbolic 4	1987	21	12	207	0.009924	0.763351	0.065628	none
Sodium	hyperbolic 4	1987	21	12	207	-0.024535	-0.124542	0.506099	none
Calcium	hyperbolic 4	1987	21	12	207	-0.107755	-0.319748	0.064358	none
Magnesium	hyperbolic 4	1987	21	12	207	-0.006746	-0.070270	0.679713	none
Bicarbonate	hyperbolic 4	1987	21	12	207	-0.027084	-0.019485	0.925037	none
Chloride	hyperbolic 4	1987	21	12	207	-0.154648	-0.904372	0.005715	down
Fluoride	hyperbolic 5	1987	21	1	21	-0.001195	-0.995502	0.174190	none
Sulphate	hyperbolic 3	1987	21	12	207	0.147318	0.579992	0.061855	none
Reactive Silica	hyperbolic 4	1987	13	1	13	-0.107583	-1.280754	0.127204	none
Total Organic Carbon	hyperbolic 7	1987	12	1	11	0.208649	2.674989	0.061707	none
Dissolved Organic Carbon	hyperbolic 2	1987	21	12	204	0.020069	0.244742	0.563884	none
Total Ammonia Nitrogen	linear	1987	21	12	201	0.000538	1.794869	0.294861	none
Total Kjeldahl Nitrogen	loess	1987	21	12	204	0.002614	0.556109	0.200477	none
Nitrate + Nitrite Nitrogen	inverse	1987	21	12	205	0.000625	1.275766	0.314091	none
Total Nitrogen	loess	1987	21	12	204	0.003442	0.603322	0.084900	none
Total Phosphorus	loess	1987	21	12	207	0.000660	1.434714	0.002493	up
Total Dissolved Phosphorus	inverse	1987	21	12	204	-0.000127	-1.058150	0.182881	none
Chlorophyll a	hyperbolic 4	1987	21	1	21	-0.000008	-1.894481	0.927818	none
Total Coliform Bacteria	loess	1987	13	1	13	-4.328132	-11.097775	0.076851	none

Appendix XIII Results of trend analyses for metals at the Athabasca sampling site. Significance was determined at a 95% confidence interval (i.e., p<0.05). Seaken = Seasonal Kendall Analysis, Censored = Censored Seasonal Kendall Analysis (for censored data, <15% censorship).

Variable	Trend Test	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Total Aluminum (mg/L)	Seaken	1994	14	4	52	0.010500	6.213018	0.013812	**up**
Total Arsenic (µg/L)	Seaken	1995	13	4	46	0.025429	5.035360	0.158401	none
Total Barium (mg/L)	Seaken	1994	14	4	50	0.000713	0.864685	0.089348	none
Total Copper (µg/L)	Seaken	1994	14	4	51	-0.057143	-3.174603	0.355277	none
Total Iron (mg/L)	Seaken	1994	14	4	51	0.005000	0.943396	0.736394	none
Total Lead (µg/L)	Censored	1997	11	4	40	0.013000	2.166667	0.526118	none
Total Zinc (mg/L)	Seaken	1994	14	4	49	-0.000039	-0.473865	0.886203	none

Appendix XIV Results of trend analyses for metals at the Old Fort sampling site. Significance was determined at a 95% confidence interval (i.e., p<0.05). Seaken = Seasonal Kendall Analysis, Censored = Censored Seasonal Kendall Analysis (for censored data, <15% censorship).

Variable	Trend Test	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Total Aluminum (mg/L)	Seaken	1995	13	4	48	0.031000	9.538462	0.004591	**up**
Total Arsenic (µg/L)	Seaken	1995	13	4	46	0.043304	6.203951	0.068088	none
Total Barium (mg/L)	Seaken	1994	14	4	49	0.000578	0.847182	0.428058	none
Total Copper (µg/L)	Seaken	1994	14	4	50	-0.159226	-5.136329	0.042005	**down**
Total Iron (mg/L)	Seaken	1994	14	4	51	0.016675	1.852778	0.282380	none
Total Molybdenum	Seaken	1995	13	4	46	-0.000056	-6.943751	0.017663	**down**
Total Lead (µg/L)	Censored	1997	11	4	40	-0.012500	-1.041665	0.740498	none
Total Zinc (mg/L)	Seaken	1994	14	4	44	-0.000256	-2.323234	0.386108	none

Appendix XV Results of trend analyses on f low adjusted data for metals at the Athabasca sampling site. Significance was determined at a 95% confidence interval (i.e., $p<0.05$).

Variable	Flow Model	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Total Aluminum (mg/L)	linear	1994	14	4	52	0.008115	4.801845	0.294316	none
Total Arsenic (µg/L)	hyperbolic 2	1995	13	4	46	0.006894	1.365108	0.518394	none
Total Barium (mg/L)	linear	1994	14	4	50	0.000302	0.366565	0.635744	none
Total Copper (µg/L)	linear	1994	14	4	51	-0.109532	-6.085135	0.058573	none
Total Iron (mg/L)	linear	1994	14	4	51	-0.015511	-2.926688	0.344725	none
Total Lead (µg/L)	linear	1997	11	4	40	-0.051299	-8.549861	0.120046	none
Total Zinc (mg/L)	hyperbolic 1	1994	14	4	49	-0.000376	-4.589794	0.260092	none

Appendix XVI Results of trend analyses on f low adjusted data for metals at the Old Fort sampling site. Significance was determined at a 95% confidence interval (i.e., $p<0.05$).

Variable	Flow Model	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Total Aluminum (mg/L)	hyperbolic 3	1995	13	4	48	0.055441	17.058850	0.031772	**up**
Total Arsenic (µg/L)	hyperbolic 2	1995	13	4	46	0.047191	6.760928	0.018092	**up**
Total Barium (mg/L)	linear	1994	14	4	49	0.001071	1.570328	0.223405	none
Total Copper (µg/L)	hyperbolic 1	1994	14	4	50	-0.185615	-5.987589	0.112417	none
Total Iron (mg/L)	linear	1994	14	4	51	0.008941	0.993425	0.860183	none
Total Molybdenum (mg/L)	inverse	1995	13	4	46	-0.000043	-5.345524	0.116479	none
Total Lead (µg/L)	linear	1997	11	4	40	-0.028529	-2.377414	0.533176	none
Total Zinc (mg/L)	linear	1994	14	4	44	-0.000157	-1.422765	0.443214	none

Appendix XVII Results of trend analyses on Water Survey of Canada flow data, 1961-2008. This time frame was selected to facilitate comparability among sites. Seaken = Uncensored Seasonal Kendall Analysis.

Station	WSC Station Code	Trend Test	Start Year	# Years	# Seasons	N	Trend Slope	% Slope	p-value	Sig.
Hinton	07AD002	Seaken	1961	47	12	555	0.035000	0.050215	0.622812	none
Athabasca	07BE001	Seaken	1961	47	12	555	-0.907197	-0.362879	0.014583	**down**
Fort McMurray	07DD011	Seaken	1961	47	12	552	-2.159593	-0.494752	0.002534	**down**

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Hinton and Athabasca sampling stations.

	Polycyclic Aromatic Hydrocarbons (PAH)																					
	3-Methylcholanthrene (µg/L)	7,12-Dimethylbenz(A)Anthracene (µg/L)	Acenaphthene (µg/L)	Acenaphthylene (µg/L)	Acridine (µg/L)	Anthracene (µg/L)	Benzo(A)Anthracene (µg/L)	Benzo(A)Pyrene (µg/L)	Benzo(B,J,K)Fluoranthene (µg/L)	Benzo(C)Phenanthrene (µg/L)	Benzo(E)Pyrene (µg/L)	Benzo(G,H,I)Perylene (µg/L)	Chrysene (µg/L)	Dibenzo(A,H)Anthracene (µg/L)	Dibenzo(A,H)Pyrene (µg/L)	Dibenzo(A,I)Pyrene (µg/L)	Dibenzo(A,L)Pyrene (µg/L)	Fluoranthene (µg/L)	Fluorene (µg/L)	Indeno(1,2,3-C,D)Pyrene (µg/L)	Naphthalene (µg/L)	Perylene (µg/L)
Hinton																						
Samples	0	0	12	12	0	12	12	12	0	0	0	12	12	12	0	0	0	12	12	12	12	1
Non-Detects	0	0	12	12	0	12	12	12	0	0	0	12	12	12	0	0	0	12	12	12	12	1
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	-	-	93	93	-	93	93	93	-	-	-	93	93	93	-	-	-	93	93	93	93	93
End Year	-	-	07	07	-	07	07	07	-	-	-	07	07	07	-	-	-	07	07	07	07	93
Athabasca																						
Samples	0	0	25	25	0	25	25	25	0	0	0	25	25	25	0	0	0	25	25	25	25	9
Non-Detects	0	0	25	25	0	25	25	25	0	0	0	25	25	25	0	0	0	25	25	25	25	9
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	-	-	90	90	-	90	90	90	-	-	-	90	90	92	-	-	-	90	90	90	90	90
End Year	-	-	07	07	-	07	07	07	-	-	-	07	07	07	-	-	-	07	07	07	07	95

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Fort McMurray and Old Fort sampling stations (continued).

	Polycyclic Aromatic Hydrocarbons (PAH)																					
	3-Methylcholanthrene (µg/L)	7,12-Dimethylbenz(A)Anthracene (µg/L)	Acenaphthene (µg/L)	Acenaphthylene (µg/L)	Acridine (µg/L)	Anthracene (µg/L)	Benzo(A)Anthracene (µg/L)	Benzo(A)Pyrene (µg/L)	Benzo(B,J,K)Fluoranthene (µg/L)	Benzo(C)Phenanthrene (µg/L)	Benzo(E)Pyrene (µg/L)	Benzo(G,H,I)Perylene (µg/L)	Chrysene (µg/L)	Dibenzo(A,H)Anthracene (µg/L)	Dibenzo(A,H)Pyrene (µg/L)	Dibenzo(A,I)Pyrene (µg/L)	Dibenzo(A,L)Pyrene (µg/L)	Fluoranthene (µg/L)	Fluorene (µg/L)	Indeno(1,2,3-C,D)Pyrene (µg/L)	Naphthalene (µg/L)	Perylene (µg/L)
Fort McMurray																						
Samples	14	15	37	37	15	37	37	37	15	15	15	37	37	37	15	15	15	37	37	37	40	19
Non-Detects	14	15	37	37	15	37	36	37	14	13	14	36	34	37	15	15	15	33	36	36	36	19
Hits	0	0	0	0	0	0	1	0	1	2	1	1	3	0	0	0	0	4	1	1	4	0
Min of Hits	-	-	-	-	-	-	0.0100	-	0.0084	0.0004	0.0027	0.0031	0.0002	-	-	-	-	0.0001	0.0001	0.0033	0.0004	-
Max of Hits	-	-	-	-	-	-	0.0100	-	0.0084	0.0006	0.0027	0.0031	0.0076	-	-	-	-	0.0046	0.0001	0.0033	0.4200	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	0.0013	-	-	-	-	0.0027	-	-	0.0040	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	0.0030	-	-	-	-	0.0025	-	-	0.1071	-
Start Year	99	99	87	87	99	87	87	87	99	99	99	87	87	87	99	99	99	87	87	87	87	87
End Year	07	07	07	07	07	06	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	95
Old Fort																						
Samples	4	4	17	17	4	17	17	17	4	4	4	17	17	17	4	4	4	17	17	17	18	9
Non-Detects	4	4	17	16	4	17	17	17	4	4	4	17	17	17	4	4	4	16	16	17	17	9
Hits	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0
Min of Hits	-	-	-	0.012	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0060	0.0038	-	0.1700	-
Max of Hits	-	-	-	0.012	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0060	0.0038	-	0.1700	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	04	04	90	90	04	90	90	90	04	04	04	90	90	90	04	04	04	90	90	90	90	90
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	95

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Hinton and Athabasca sampling stations (continued). *Phthalate data are undergoing review and not included here.

	PAH			Extractable Priority Pollutants (EPP)																								
	Phenanthrene (µg/L)	Pyrene (µg/L)	Retene (µg/L)	1,2-Diphenylhydrazine (µg/L)	2,4-Dimethylphenol (µg/L)	2,4-Dinitrophenol (µg/L)	2,4-Dinitrotoluene (µg/L)	2,6-Dinitrotoluene (µg/L)	2-Chloronaphthalene (µg/L)	2-Chlorophenol (µg/L)	2-Methyl-4,6-Dinitrophenol (µg/L)	2-Nitrophenol (µg/L)	4-Bromophenyl Phenyl Ether (µg/L)	4-Chloro-2-Methylphenol (µg/L)	4-Chloro-3-Methylphenol (µg/L)	4-Chlorophenyl Phenyl Ether (µg/L)	4-Nitrophenol (µg/L)	Benzidine (µg/L)	Benzo(B)Fluoranthene (µg/L)	Benzo(K)Fluoranthene (µg/L)	Bis(2-Chloroethoxy) Methane (µg/L)	Bis(2-Chloroethyl) Ether (µg/L)	Bis(2-Chloroisopropyl) Ether (µg/L)	Hexachlorobenzene (µg/L)	Hexachlorobutadiene (µg/L)	Hexachlorocyclopentadiene (µg/L)	Hexachloroethane (µg/L)	Isophorone (µg/L)
Hinton																												
Samples	12	12	0	12	12	12	12	12	12	12	12	12	12	20	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Non-Detects	12	12	0	12	12	12	12	12	12	12	12	12	12	20	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	93	93	-	93	93	93	93	93	93	93	93	93	93	02	93	93	93	93	93	93	93	93	93	93	93	93	93	93
End Year	07	07	-	07	07	07	07	07	07	07	07	07	07	06	07	07	07	07	07	07	07	07	07	07	07	07	07	07
Athabasca																												
Samples	25	25	0	25	25	25	25	25	25	25	25	25	25	19	25	25	25	25	25	25	25	25	25	48	25	25	25	25
Non-Detects	25	25	0	25	25	25	25	25	25	25	25	25	25	19	25	25	25	25	25	25	25	25	25	48	25	25	25	25
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	90	90	-	90	90	90	90	90	90	90	90	90	90	02	90	90	90	90	90	90	90	90	90	87	90	90	90	90
End Year	07	07	-	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Fort McMurray and Old Fort sampling stations (continued). *Phthalate data are undergoing review and not included here.

	PAH			Extractable Priority Pollutants (EPP)																								
	Phenanthrene (µg/L)	Pyrene (µg/L)	Retene (µg/L)	1,2-Diphenylhydrazine (µg/L)	2,4-Dimethylphenol (µg/L)	2,4-Dinitrophenol (µg/L)	2,4-Dinitrotoluene (µg/L)	2,6-Dinitrotoluene (µg/L)	2-Chloronaphthalene (µg/L)	2-Chlorophenol (µg/L)	2-Methyl-4,6-Dinitrophenol (µg/L)	2-Nitrophenol (µg/L)	4-Bromophenyl Phenyl Ether (µg/L)	4-Chloro-2-Methylphenol (µg/L)	4-Chloro-3-Methylphenol (µg/L)	4-Chlorophenyl Phenyl Ether (µg/L)	4-Nitrophenol (µg/L)	Benzidine (µg/L)	Benzo(B)Fluoranthene (µg/L)	Benzo(K)Fluoranthene (µg/L)	Bis(2-Chloroethoxy) Methane (µg/L)	Bis(2-Chloroethyl) Ether (µg/L)	Bis(2-Chloroisopropyl) Ether (µg/L)	Hexachlorobenzene (µg/L)	Hexachlorobutadiene (µg/L)	Hexachlorocyclopentadiene (µg/L)	Hexachloroethane (µg/L)	Isophorone (µg/L)
Fort McMurray																												
Samples	37	37	11	30	30	30	30	30	30	30	30	30	30	20	30	30	30	30	30	30	30	30	30	30	33	30	30	30
Non-Detects	34	37	10	30	30	30	30	30	30	30	30	30	30	20	30	30	30	30	30	30	30	30	30	30	33	30	30	30
Hits	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	0.0001	-	0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	0.0130	-	0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	0.0014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	0.0048	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	87	87	01	87	87	87	87	87	87	87	87	87	87	02	87	87	87	87	87	87	87	87	87	87	87	87	87	87
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	06	07	07	07	07	07	07	07	07	07	07	07	07	07	07
Old Fort																												
Samples	17	17	4	14	14	14	14	14	14	14	14	14	14	21	14	14	14	14	14	14	14	14	14	35	15	14	14	14
Non-Detects	16	16	3	14	14	14	14	14	14	14	14	14	14	21	14	14	14	14	14	14	14	14	14	35	15	14	14	14
Hits	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	0.0110	0.008	0.021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	0.0110	0.008	0.021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	90	90	04	90	90	90	90	90	90	90	90	90	90	02	90	90	90	90	90	90	90	90	90	88	90	90	90	90
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Hinton and Athabasca sampling stations (continued).

	EPP				Volatile Priority Pollutants																									
	Nitrobenzene (µg/L)	N-Nitroso-Di-N-Propylamine (µg/L)	N-Nitrosodiphenylamine (µg/L)	Phenol (µg/L)	1,1,1,2-Tetrachloroethane (µg/L)	1,1,1-Trichloroethane (µg/L)	1,1,2,2-Tetrachloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethylene (µg/L)	1,1-Dichloropropylene (µg/L)	1,2,3-Trichlorobenzene (µg/L)	1,2,3-Trichloropropane (µg/L)	1,2,4-Trichlorobenzene (µg/L)	1,2,4-Trimethylbenzene (µg/L)	1,2-Dibromo-3-Chloropropane (µg/L)	1,2-Dibromoethane (µg/L)	1,2-Dichlorobenzene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloropropane (µg/L)	1,3,5-Trimethylbenzene (µg/L)	1,3-Dichlorobenzene (µg/L)	1,3-Dichloropropane (µg/L)	1,4-Dichlorobenzene (µg/L)	2,2-Dichloropropane (µg/L)	2-Chloroethylvinylether (2-Chloroethoxyethylene) (µg/L)	2-Chlorotoluene (µg/L)	4-Chlorotoluene (µg/L)	Benzene (µg/L)	Bromobenzene (µg/L)
Hinton																														
Samples	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Non-Detects	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07
Athabasca																														
Samples	25	25	25	25	21	22	22	22	22	22	21	21	21	25	21	21	21	22	22	22	21	22	21	22	21	22	21	21	22	21
Non-Detects	25	25	25	25	21	22	22	22	22	22	21	21	21	25	21	21	21	22	22	22	21	22	21	22	21	22	21	21	22	21
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	90	90	90	90	93	92	92	92	92	92	93	93	93	90	93	93	93	92	92	92	93	92	93	92	93	92	93	93	92	93
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07

Appendix XVIII Summary stats for trace organic contaminants in the Athabasca River at the Fort McMurray and Old Fort sampling stations (continued).

	EPP				Volatile Priority Pollutants																									
	Nitrobenzene (µg/L)	N-Nitroso-Di-N-Propylamine (µg/L)	N-Nitrosodiphenylamine (µg/L)	Phenol (µg/L)	1,1,1,2-Tetrachloroethane (µg/L)	1,1,1-Trichloroethane (µg/L)	1,1,2,2-Tetrachloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	1,1-Dichloroethane (µg/L)	1,1-Dichloroethylene (µg/L)	1,1-Dichloropropylene (µg/L)	1,2,3-Trichlorobenzene (µg/L)	1,2,3-Trichloropropane (µg/L)	1,2,4-Trichlorobenzene (µg/L)	1,2,4-Trimethylbenzene (µg/L)	1,2-Dibromo-3-Chloropropane (µg/L)	1,2-Dibromoethane (µg/L)	1,2-Dichlorobenzene (µg/L)	1,2-Dichloroethane (µg/L)	1,2-Dichloropropane (µg/L)	1,3,5-Trimethylbenzene (µg/L)	1,3-Dichlorobenzene (µg/L)	1,3-Dichloropropane (µg/L)	1,4-Dichlorobenzene (µg/L)	2,2-Dichloropropane (µg/L)	2-Chloroethylvinylether (2-Chloroethoxyethylene) (µg/L)	2-Chlorotoluene (µg/L)	4-Chlorotoluene (µg/L)	Benzene (µg/L)	Bromobenzene (µg/L)
Fort McMurray																														
Samples	30	30	30	30	19	25	25	25	25	25	19	19	19	33	19	19	19	25	25	25	19	25	19	25	19	25	19	19	25	19
Non-Detects	30	30	30	30	19	25	25	25	25	25	19	19	19	33	18	19	19	25	25	25	19	25	19	25	19	25	19	19	25	19
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	87	87	87	87	91	89	89	89	89	89	91	91	91	87	91	91	91	89	89	89	91	89	91	89	91	89	91	91	89	91
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07
Old Fort																														
Samples	14	14	14	14	11	12	12	12	12	12	11	11	11	15	11	11	11	12	12	12	11	12	11	12	11	12	11	11	12	11
Non-Detects	14	14	14	14	11	12	12	12	12	12	11	11	11	15	10	11	11	12	12	12	10	12	11	11	11	12	11	11	11	11
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.64	-	-	-	-	-	1.40	-	-	0.05	-	-	-	-	0.4200	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.64	-	-	-	-	-	1.40	-	-	0.05	-	-	-	-	0.4200	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	90	90	90	90	93	92	92	92	92	92	93	93	93	90	93	93	93	92	92	92	93	92	93	92	93	92	93	93	92	93
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Hinton and Athabasca sampling stations (continued).

	Volatile Priority Pollutants																												
	Bromodichloromethane (µg/L)	Bromoform (µg/L)	Bromomethane (µg/L)	Carbon Tetrachloride (µg/L)	Chlorobenzene (µg/L)	Chloroethane (µg/L)	Chloroform (µg/L)	Chloromethane (µg/L)	Cis-1,2-Dichloroethylene (µg/L)	Cis-1,3-Dichloropropene (µg/L)	Dibromomethane (µg/L)	Dichlorobromomethane (µg/L)	Ethyl Benzene (µg/L)	Isopropylbenzene (µg/L)	M- + P-Xylene (µg/L)	Methyl Tertiary Butyl Ether (MTBE) (µg/L)	Methylene Chloride (Dichloromethane) (µg/L)	N-Butylbenzene (µg/L)	N-Propylbenzene (µg/L)	O-Xylene (µg/L)	P-Isopropyltoluene (µg/L)	Sec-Butylbenzene (µg/L)	Styrene (µg/L)	Tert-Butylbenzene (µg/L)	Tetrachloroethylene (µg/L)	Toluene (µg/L)	Trans-1,2-Dichloroethylene (µg/L)	Trans-1,3-Dichloropropylene (µg/L)	Trichloroethylene (µg/L)
Hinton																													
Samples	12	12	12	12	12	12	11	1	12	12	12	12	12	12	12	11	11	12	12	12	12	12	12	12	12	12	12	11	12
Non-Detects	12	12	12	12	12	12	11	1	12	12	12	12	12	12	12	11	10	12	12	12	12	12	12	12	12	12	12	11	12
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	93	93	93	93	93	93	93	07	93	93	93	93	93	93	93	99	99	93	93	93	93	93	93	93	93	93	93	99	93
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07
Athabasca																													
Samples	22	22	22	22	22	22	22	3	21	22	22	22	22	21	22	13	22	21	21	22	21	21	22	21	22	22	22	21	21
Non-Detects	22	22	22	22	22	22	21	3	21	22	22	22	22	21	22	13	21	21	21	22	21	21	22	21	22	22	22	21	21
Hits	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	0.14	-	-	-	-	-	-	-	-	-	0.16	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	0.14	-	-	-	-	-	-	-	-	-	0.16	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	92	92	92	92	92	92	92	94	93	92	92	92	92	93	92	98	92	93	93	92	39	93	92	93	92	92	92	92	93
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Fort McMurray and Old Fort sampling stations (continued).

	Volatile Priority Pollutants																												
	Dibromochloromethane (µg/L)	Bromoform (µg/L)	Bromomethane (µg/L)	Carbon Tetrachloride (µg/L)	Chlorobenzene (µg/L)	Chloroethane (µg/L)	Chloroform (µg/L)	Chloromethane (µg/L)	Cis-1,2-Dichloroethene (µg/L)	Cis-1,3-Dichloropropene (µg/L)	Dibromomethane (µg/L)	Dichlorobromomethane (µg/L)	Ethyl Benzene (µg/L)	Isopropylbenzene (µg/L)	M- + P-Xylene (µg/L)	Methyl Tertiary Butyl Ether (MTBE) (µg/L)	Methylene Chloride (Dichloromethane) (µg/L)	N-Butylbenzene (µg/L)	N-Propylbenzene (µg/L)	O-Xylene (µg/L)	P-Isopropyltoluene (µg/L)	Sec-Butylbenzene (µg/L)	Styrene (µg/L)	Tert-Butylbenzene (µg/L)	Tetrachloroethylene (µg/L)	Toluene (µg/L)	Trans-1,2-Dichloroethene (µg/L)	Trans-1,3-Dichloropropene (µg/L)	Trichloroethylene (µg/L)
Fort McMurray																													
Samples	25	25	25	25	25	25	25	4	19	25	21	25	25	19	25	10	25	19	19	25	19	19	25	19	25	25	25	23	25
Non-Detects	25	25	25	25	25	25	21	4	19	25	21	25	25	19	24	10	21	19	19	25	19	19	25	19	25	22	25	23	25
Hits	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1	0	4	0	0	0	0	0	0	0	0	3	0	0	0
Min of Hits	-	-	-	-	-	-	0.02	-	-	-	-	-	-	-	0.1000	-	2.00	-	-	-	-	-	-	-	-	0.040	-	-	-
Max of Hits	-	-	-	-	-	-	0.04	-	-	-	-	-	-	-	0.1000	-	8.00	-	-	-	-	-	-	-	-	0.100	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.00	-	-	-	-	-	-	-	-	0.098	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.00	-	-	-	-	-	-	-	-	0.079	-	-	-
Start Year	89	89	89	89	89	89	89	94	91	89	91	89	89	91	89	98	89	91	91	89	91	91	89	91	89	89	89	89	89
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07
Old Fort																													
Samples	12	12	12	12	12	12	12	2	11	12	12	12	12	11	12	4	12	11	11	12	11	11	12	11	12	12	12	11	12
Non-Detects	12	12	12	12	12	12	11	2	11	12	12	12	11	11	11	4	11	11	11	11	11	11	12	11	12	10	12	11	12
Hits	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	2	0	0	0
Min of Hits	-	-	-	-	-	-	0.02	-	-	-	-	-	1.01	-	5.5300	-	1.05	-	-	2.71	-	-	-	-	-	0.010	-	-	-
Max of Hits	-	-	-	-	-	-	0.02	-	-	-	-	-	1.01	-	5.5300	-	1.05	-	-	2.71	-	-	-	-	-	3.280	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	92	92	92	92	92	92	92	95	93	92	92	92	92	93	92	99	92	93	93	92	93	93	92	93	92	92	92	92	92
End Year	07	07	07	07	07	07	07	95	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Hinton and Athabasca sampling stations (continued).

	VPP				Pulp and Paper Chlorinated Phenols (PPCP)																			
	Trichlorofluoromethane (µg/L)	Trihalomethanes (µg/L)	Vinyl Chloride (µg/L)	Xylene (µg/L)	2,3,4,6-Tetrachlorophenol (µg/L)	2,3,6-Trichlorophenol (µg/L)	2,4,6-Trichlorophenol (µg/L)	2,4-Dichlorophenol (µg/L)	3,4,5-Trichlorocatecol (µg/L)	3,4,5-Trichloroguaiacol (µg/L)	3,4,5-Trichloroveratrol (µg/L)	3,4,6-Trichlorocatechol (µg/L)	3,4,6-Trichloroguaiacol (µg/L)	3,4-Dichlorocatechol (µg/L)	3,5-Dichlorocatechol (µg/L)	4,5,6-Trichloroguaiacol (µg/L)	4,5,6-Trichlorosyringol (µg/L)	4,5-Dichlorocatechol (µg/L)	4,5-Dichloroguaiacol (µg/L)	4,5-Dichloroveratrole (µg/L)	4,6-Dichloroguaiacol (µg/L)	4-Chlorocatechol (µg/L)	4-Chloroguaiacol (µg/L)	4-Chlorophenol (µg/L)
Hinton																								
Samples	12	6	12	6	10	4	12	32	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Non-Detects	12	6	12	6	10	4	12	32	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	93	02	93	02	93	04	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07
Athabasca																								
Samples	22	6	22	6	18	4	29	48	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
Non-Detects	21	5	22	6	16	4	27	48	16	13	15	16	16	17	17	15	15	15	15	17	16	15	15	17
Hits	1	1	0	0	2	0	2	0	1	4	2	1	1	0	0	2	2	2	2	0	1	2	2	0
Min of Hits	0.32	0.14	-	-	0.01	-	0.061	-	0.111	0.020	0.010	0.02	0.014	-	-	0.02	0.03	0.025	0.034	-	0.01	0.010	0.01	-
Max of Hits	0.32	0.14	-	-	0.01	-	0.064	-	0.111	0.170	0.022	0.02	0.014	-	-	0.02	0.03	0.030	0.043	-	0.01	0.015	0.02	-
Median of Hits	-	-	-	-	-	-	-	-	-	0.088	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	0.091	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	92	02	92	02	92	04	90	90	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Fort McMurray and Old Fort sampling stations (continued).

	VPP				Pulp and Paper Chlorinated Phenols (PPCP)																			
	Trichlorofluoromethane (µg/L)	Trihalomethanes (µg/L)	Vinyl Chloride (µg/L)	Xylene (µg/L)	2,3,4,6-Tetrachlorophenol (µg/L)	2,3,6-Trichlorophenol (µg/L)	2,4,6-Trichlorophenol (µg/L)	2,4-Dichlorophenol (µg/L)	3,4,5-Trichlorocatecol (µg/L)	3,4,5-Trichloroguaiacol (µg/L)	3,4,5-Trichloroveratrol (µg/L)	3,4,6-Trichlorocatechol (µg/L)	3,4,6-Trichloroguaiacol (µg/L)	3,4-Dichlorocatechol (µg/L)	3,5-Dichlorocatechol (µg/L)	4,5,6-Trichloroguaiacol (µg/L)	4,5,6-Trichlorosyringol (µg/L)	4,5-Dichlorocatechol (µg/L)	4,5-Dichloroguaiacol (µg/L)	4,5-Dichloroveratrole (µg/L)	4,6-Dichloroguaiacol (µg/L)	4-Chlorocatechol (µg/L)	4-Chloroguaiacol (µg/L)	4-Chlorophenol (µg/L)
Fort McMurray																								
Samples	25	6	25	6	27	4	44	64	27	27	27	27	26	27	27	27	27	27	27	27	27	26	27	27
Non-Detects	25	5	25	6	27	4	38	64	23	18	23	27	24	27	27	27	27	25	19	27	26	24	27	27
Hits	0	1	0	0	0	0	6	0	4	9	4	0	2	0	0	0	0	2	8	0	1	2	0	0
Min of Hits	-	0.04	-	-	-	-	0.006	-	0.010	0.005	0.020	-	0.003	-	-	-	-	0.002	0.010	-	0.001	0.001	-	-
Max of Hits	-	0.04	-	-	-	-	0.050	-	0.037	0.100	0.042	-	0.020	-	-	-	-	0.020	0.082	-	0.001	0.011	-	-
Median of Hits	-	-	-	-	-	-	0.035	-	0.025	0.048	0.026	-	0.012	-	-	-	-	-	0.030	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	0.033	-	0.024	0.053	0.028	-	0.012	-	-	-	-	-	0.034	-	-	-	-	-
Start Year	89	02	89	02	91	04	87	87	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07
Old Fort																								
Samples	12	1	12	1	8	1	19	40	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Non-Detects	12	1	12	0	8	1	17	40	6	6	7	7	7	7	7	7	7	7	6	7	7	7	7	7
Hits	0	0	0	1	0	0	2	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Min of Hits	-	-	-	8.24	-	-	0.017	-	0.025	0.051	-	-	-	-	-	-	-	-	0.025	-	-	-	-	-
Max of Hits	-	-	-	8.24	-	-	0.021	-	0.025	0.051	-	-	-	-	-	-	-	-	0.025	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	92	04	92	04	92	04	90	90	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Hinton and Athabasca sampling stations (continued).

	PPCP				Resin Acids											Pesticides							
	Pentachlorophenol (µg/L)	Tetrachlorocatecol (µg/L)	Tetrachloroguaiacol (µg/L)	Tetrachloroveratrol (µg/L)	12,14-Dichlorodehydroabietic Acid (µg/L)	12-Chlorodehydroabietic Acid (µg/L)	14-Chlorodehydroabietic Acid (µg/L)	Abietic Acid (µg/L)	Dehydroabietic Acid (µg/L)	Isopimaric Acid (µg/L)	Levopimaric Acid (µg/L)	Neoabietic Acid (µg/L)	Palustric Acid (µg/L)	Pimaric Acid (µg/L)	Sandaracopimaric Acid (µg/L)	2,4-D (Dichlorophenoxyacetic Acid) (µg/L)	2,4-DB (µg/L)	Dichlorprop(2,4-DP) (µg/L)	Alpha-Benzenehexachloride(BHC) (µg/L)	Alpha-Endosulfan (µg/L)	Gamma-Benzenehexachloride (Lindane) (Gamma-BHC) (µg/L)	Methoxychlor (P,P'-Methoxychlor) (µg/L)	Atrazine (µg/L)
Hinton																							
Samples	13	9	9	9	9	9	9	9	9	9	9	9	9	9	9	23	23	23	23	23	23	23	23
Non-Detects	13	9	9	9	9	9	9	9	9	9	9	9	9	9	9	23	23	23	23	23	23	23	23
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	03	03	03	03	03	03	03	03
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	08	08	08	08	08	08	08	08
Athabasca																							
Samples	29	17	17	17	15	15	15	15	15	15	15	15	15	14	15	60	61	61	61	61	61	61	61
Non-Detects	29	15	15	17	15	15	15	12	13	12	15	15	15	11	14	57	61	61	61	61	61	61	61
Hits	0	2	2	0	0	0	0	3	2	3	0	0	0	3	1	3	0	0	0	0	0	0	0
Min of Hits	-	0.04	0.044	-	-	-	-	0.10	0.100	0.100	-	-	-	0.300	0.10	0.0050	-	-	-	-	-	-	-
Max of Hits	-	0.05	0.089	-	-	-	-	0.20	0.200	0.200	-	-	-	0.300	0.10	0.0140	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	0.10	-	0.100	-	-	-	0.300	-	0.0090	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	0.13	-	0.133	-	-	-	0.300	-	0.0093	-	-	-	-	-	-	-
Start Year	90	92	92	92	92	92	92	92	92	92	92	92	92	93	92	95	95	95	95	95	95	95	95
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	08	08	08	08	08	08	08	08

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Fort McMurray and Old Fort sampling stations (continued).

	PPCP				Resin Acids											Pesticides							
	Pentachlorophenol (µg/L)	Tetrachlorocatecol (µg/L)	Tetrachloroguaiacol (µg/L)	Tetrachloroveratrol (µg/L)	12,14-Dichlorodehydroabietic Acid (µg/L)	12-Chlorodehydroabietic Acid (µg/L)	14-Chlorodehydroabietic Acid (µg/L)	Abietic Acid (µg/L)	Dehydroabietic Acid (µg/L)	Isopimaric Acid (µg/L)	Levopimaric Acid (µg/L)	Neoabietic Acid (µg/L)	Palustric Acid (µg/L)	Pimaric Acid (µg/L)	Sandaracopimaric Acid (µg/L)	2,4-D (Dichlorophenoxyacetic Acid (µg/L)	2,4-DB (µg/L)	Dichlorprop(2,4-DP) (µg/L)	Alpha-Benzenehexachloride (BHC) (µg/L)	Alpha-Endosulfan (µg/L)	Gamma-Benzenehexachloride (Lindane) (Gamma-BHC) (µg/L)	Methoxychlor (P,P'-Methoxychlor) (µg/L)	Atrazine (µg/L)
Fort McMurray																							
Samples	44	27	27	27	20	20	20	20	20	20	20	20	20	19	20	27	27	27	27	27	27	26	27
Non-Detects	44	27	21	26	20	19	19	17	14	15	20	20	20	13	18	27	27	27	27	27	27	26	27
Hits	0	0	6	1	0	1	1	3	6	5	0	0	0	6	2	0	0	0	0	0	0	0	0
Min of Hits	-	-	0.016	0.029	-	0.05	0.11	0.06	0.030	0.100	-	-	-	0.080	0.02	-	-	-	-	-	-	-	-
Max of Hits	-	-	0.050	0.029	-	0.05	0.11	0.20	0.200	0.200	-	-	-	0.300	0.11	-	-	-	-	-	-	-	-
Median of Hits	-	-	0.024	-	-	-	-	0.10	0.110	0.100	-	-	-	0.100	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	0.029	-	-	-	-	0.12	0.117	0.120	-	-	-	0.147	-	-	-	-	-	-	-	-	-
Start Year	87	91	91	91	91	91	91	91	91	91	91	91	91	91	19	02	02	02	02	02	02	02	02
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	08	08	08	08	08	08	08	08
Old Fort																							
Samples	19	7	7	7	4	4	4	4	4	4	4	4	4	3	4	51	51	51	51	51	51	51	51
Non-Detects	19	7	7	7	4	4	4	3	2	4	4	4	4	2	4	49	51	51	51	51	51	51	51
Hits	0	0	0	0	0	0	0	1	2	0	0	0	0	1	0	2	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	0.03	0.550	-	-	-	-	0.010	-	0.0050	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	0.03	0.800	-	-	-	-	0.010	-	0.0120	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	90	92	92	92	92	92	92	92	92	92	92	92	92	93	92	96	96	96	96	96	96	96	96
End Year	07	07	07	07	07	07	07	07	07	07	07	07	07	07	07	08	08	08	08	08	08	08	08

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Hinton and Athabasca sampling stations (continued).

	Pesticides																												
	Bromacil (µg/L)	Bromoxynil (µg/L)	Carbathiin (Carboxin) (µg/L)	Cyanazine (µg/L)	Diazinon (µg/L)	Diclofop-Methyl (Hoegrass) (µg/L)	Disulfoton (Di-Syston) (µg/L)	Diuron (µg/L)	Chlorpyrifos-Ethyl (Dursban) (µg/L)	Ethalfluralin (Edge) (µg/L)	Ethion (µg/L)	Guthion (Azinphos Methyl) (Azinphos Ethyl) (µg/L)	Clopyralid (Lontrel) (µg/L)	Malathion (µg/L)	MCPA (µg/L)	MCPB (µg/L)	MCPP (Mecoprop) (µg/L)	Picloram (Tordon) (µg/L)	Phorate (Thimet) (µg/L)	Terbufos (µg/L)	Triallate (Avadex BW) (µg/L)	Trifluralin (Treflan) (µg/L)	Imazamethabenz-Methyl (µg/L)	Desethyl Atrazine (µg/L)	Desisopropyl Atrazine (µg/L)	Quinclorac (µg/L)	Imazethapyr (µg/L)	Fenoxaprop-P-Ethyl (µg/L)	Pyridaben (µg/L)	Dimethoate (Cygon) (µg/L)
Hinton																													
Samples	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Non-Detects	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03	03
End Year	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08
Athabasca																													
Samples	61	61	61	61	61	61	61	61	61	61	61	61	61	51	51	61	61	51	51	61	61	61	49	45	45	45	45	45	45	45
Non-Detects	61	61	61	61	61	61	61	61	61	61	61	61	61	51	50	61	61	51	51	61	61	61	49	45	45	45	45	45	45	45
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.053	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.053	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	97	98	98	98	98	98	98	98
End Year	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Fort McMurray and Old Fort sampling stations (continued).

	Pesticides																													
	Bromacil (µg/L)	Bromoxynil (µg/L)	Carbathiin (Carboxin) (µg/L)	Cyanazine (µg/L)	Diazinon (µg/L)	Diclofop-Methyl (Hoegrass) (µg/L)	Disulfoton (Di-Syston) (µg/L)	Diuron (µg/L)	Chlorpyrifos-Ethyl (Dursban) (µg/L)	Ethalfluralin (Edge) (µg/L)	Ethion (µg/L)	Guthion (Azinphos Methyl) (Azinphos Ethyl) (µg/L)	Clopyralid (Lontrel) (µg/L)	Malathion (µg/L)	MCPA (µg/L)	MCPB (µg/L)	MCPP (Mecoprop) (µg/L)	Picloram (Tordon) (µg/L)	Phorate (Thimet) (µg/L)	Terbufos (µg/L)	Triallate (Avadex BW) (µg/L)	Trifluralin (Treflan) (µg/L)	Imazamethabenz-Methyl (µg/L)	Desethyl Atrazine (µg/L)	Desisopropyl Atrazine (µg/L)	Quinclorac (µg/L)	Imazethapyr (µg/L)	Fenoxaprop-P-Ethyl (µg/L)	Pyridaben (µg/L)	Dimethoate (Cygon) (µg/L)
Fort McMurray																														
Samples	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
Non-Detects	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02
End Year	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08
Old Fort																														
Samples	51	51	51	51	51	51	51	51	51	51	51	51	51	50	50	51	51	50	50	51	51	51	48	45	45	45	44	45	45	45
Non-Detects	51	51	51	51	51	51	51	51	51	51	51	51	51	50	49	51	50	50	50	51	51	51	48	45	45	45	44	45	45	45
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.006		0.009	-	-	-	-	-	-	-	-	-	-	-	-	-
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.006		0.009	-	-	-	-	-	-	-	-	-	-	-	-	-
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Start Year	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	97	98	98	98	98	98	98	98
End Year	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Hinton and Athabasca sampling stations (continued).

	Aldrin (µg/L)	Dieldrin (µg/L)	Metolachlor (µg/L)	Imazamox (µg/L)	Parathion (µg/L)	Metribuzin (µg/L)	Dicamba (Banvel) (µg/L)	Simazine (µg/L)	Triclopyr (µg/L)	Aminopyralid (µg/L)	Napropamide (µg/L)	Thiamethoxam (µg/L)	Vinclozolin (µg/L)	Oxycarboxin (µg/L)	Methomyl (µg/L)	Aldicarb (µg/L)	Clodinafop-Propargyl (µg/L)	Clodinafop Acid Metabolite (µg/L)	4-Chloro-2-Methylphenol (µg/L)	2,4-Dichlorophenol (µg/L)	Chlorothalonil (µg/L)	Iprodione (µg/L)	Propiconazole (µg/L)	Hexaconazole (µg/L)	Metalaxyl-M (µg/L)	Fluazifop (µg/L)	Fluroxypyr (µg/L)	Quizalofop (µg/L)	Bentazon (µg/L)	Ethofumesate (µg/L)	Linuron (µg/L)	Adsorbable Organic Halide - AOX mg/L
	Pesticides																															AOX
Hinton																																
Samples	23	23	17	23	17	17	23	23	23	8	20	16	20	20	16	20	17	17	23	23	17	17	17	17	17	17	17	17	17	17	17	17
Non-Detects	23	23	17	23	17	17	23	23	23	8	20	16	20	20	16	20	17	17	23	23	17	17	17	17	17	17	17	17	17	17	17	10
Hits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Min of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.006
Max of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.070
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.020
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.028
Start Year	03	03	05	03	05	05	03	03	03	07	04	05	04	04	05	04	05	05	03	03	05	05	05	05	05	05	05	05	05	05	05	93
End Year	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	07
Athabasca																																
Samples	24	24	17	41	17	17	32	28	28	8	20	16	20	20	16	20	17	17	27	27	17	17	17	17	17	17	17	17	17	17	17	56
Non-Detects	24	24	17	41	17	17	32	28	26	8	20	16	20	20	16	20	17	17	27	27	17	17	17	17	17	17	17	17	17	17	17	1
Hits	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55
Min of Hits	-	-	-	-	-	-	-	-	0.008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005
Max of Hits	-	-	-	-	-	-	-	-	0.020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.141
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.027
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.041
Start Year	03	03	03	02	03	03	01	02	02	07	04	05	04	04	05	04	03	03	02	02	03	03	03	03	03	03	03	03	03	03	03	90
End Year	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	07

Appendix XVIII Summary statistics for trace organic contaminants in the Athabasca River at the Fort McMurray and Old Fort sampling stations (continued).

	Pesticides																															AOX
	Aldrin (µg/L)	Dieldrin (µg/L)	Metolachlor (µg/L)	Imazamox (µg/L)	Parathion (µg/L)	Metribuzin (µg/L)	Dicamba (Banvel) (µg/L)	Simazine (µg/L)	Triclopyr (µg/L)	Aminopyralid (µg/L)	Napropamide (µg/L)	Thiamethoxam (µg/L)	Vinclozolin (µg/L)	Oxycarboxin (µg/L)	Methomyl (µg/L)	Aldicarb (µg/L)	Clodinafop-Propargyl (µg/L)	Clodinafop Acid Metabolite (µg/L)	4-Chloro-2-Methylphenol (µg/L)	2,4-Dichlorophenol (µg/L)	Chlorothalonil (µg/L)	Iprodione (µg/L)	Propiconazole (µg/L)	Hexaconazole (µg/L)	Metalaxyl-M (µg/L)	Fluazifop (µg/L)	Fluroxypyr (µg/L)	Quizalofop (µg/L)	Bentazon (µg/L)	Ethofumesate (µg/L)	Linuron (µg/L)	Adsorbable Organic Halide - AOX mg/L
Fort McMurray																																
Samples	23	23	14	27	14	14	27	27	27	7	19	13	19	19	15	19	14	14	27	27	14	14	14	14	14	14	14	14	14	14	14	54
Non-Detects	23	23	14	27	14	14	27	27	26	7	19	13	19	19	15	19	14	14	27	27	14	14	14	14	14	14	14	14	14	14	14	1
Hits	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53
Min of Hits	-	-	-	-	-	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.004
Max of Hits	-	-	-	-	-	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.118
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.022
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.035
Start Year	03	03	03	02	03	03	02	02	02	07	04	05	04	04	05	04	03	03	02	02	03	03	03	03	03	03	03	03	03	03	03	90
End Year	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	07
Old Fort																																
Samples	26	26	19	42	19	19	34	30	30	9	22	18	22	22	18	22	19	19	30	30	19	19	19	19	19	19	19	19	19	19	19	41
Non-Detects	26	26	19	42	19	19	34	30	28	9	22	18	22	22	18	22	19	19	30	30	19	19	19	19	19	19	19	19	19	19	19	1
Hits	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40
Min of Hits	-	-	-	-	-	-	-	-	0.008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.003
Max of Hits	-	-	-	-	-	-	-	-	0.015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.075
Median of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.020
Mean of Hits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.027
Start Year	03	03	05	99	05	05	01	02	02	07	04	05	04	04	05	04	05	05	02	02	05	05	05	05	05	05	05	05	05	05	05	90
End Year	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	07